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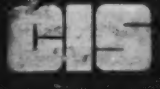

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Calendar No. 814

101ST CONGRESS *2d Session*	SENATE	REPORT 101-455

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, FISCAL YEAR 1991

Mr. HOLLINGS, from the Committee on Commerce, Science, and Transportation, submitted the following

REPORT

OF THE

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ON

S. 2287

SEPTEMBER 11 (legislative day, SEPTEMBER 10), 1990.—Ordered to be printed

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U.S. GOVERNMENT PRINTING OFFICE

39-010 WASHINGTON : 1990

S263-48

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Calendar No. 814

101ST CONGRESS
2d Session

SENATE

REPORT
101-455

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, FISCAL YEAR 1991

SEPTEMBER 11 (legislative day, SEPTEMBER 10), 1990.—Ordered to be printed

Mr. HOLLINGS, from the Committee on Commerce, Science, and Transportation, submitted the following

REPORT

[To accompany S. 2287]

The Committee on Commerce, Science, and Transportation, to which was referred the bill (S. 2287) to authorize appropriations to the National Aeronautics and Space Administration for research and development, space flight, control and data communications, construction of facilities, and research and program management, and for other purposes, having considered the same, reports favorably thereon with an amendment in the nature of a substitute and recommends that the bill as amended do pass.

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations to the National Aeronautics and Space Administration (NASA) totalling $14,755,200,000 for fiscal year (FY) 1991 as follows:

Fiscal year 1991	Budget request	Committee authorization
Research and development	$7,074,000,000	$6,804,000,000
Space flight, control, and data communications	[1] 5,289,400,000	[1] 5,189,400,000
Construction of facilities	497,900,000	497,900,000
Research and program management	2,252,900,000	2,252,900,000
Inspector General	11,000,000	11,000,000

[1] The bill also includes a one-time authorization in FY 1991 of $1,209,732,000 to be used only for the purpose of reducing all outstanding debt on the Tracking and Data Relay Satellite System to the Federal Financing Bank.

LEGISLATIVE HISTORY

On February 26, 1990, the Administration submitted its FY 1991 budget request for NASA to the Congress. Six hearings were held by the Committee on the budget request and related policy matters, including an overview of the NASA budget request (March 3), Space Station Freedom and space transportation systems (March 28), Mission to Planet Earth (April 3), aeronautical and space technology research development programs (May 3), space science and applications programs (May 10), and commercial space programs (May 15). The Committee received testimony from the NASA Administrator (administrator) and senior NASA officials associated with the major program elements, the Director of the Office of Commercial Space Transportation (OCST) of the Department of Transportation (DOT), and the space science, space transportation, space exploration, commercial space, educational, and earth sciences communities.

On March 9, 1990, Senator Gore, along with Senator Hollings introduced, by request, S. 2287, a bill to authorize appropriations for NASA for FY 1991. On June 27, 1990, the Committee met in open executive session and, without objection, ordered S. 2287 reported with an amendment in the nature of a substitute. The amendment includes language authorizing appropriations for FY 1991 for NASA, DOT's OCST and the National Space Council.

SUMMARY OF MAJOR PROVISIONS

For FY 1991, the bill, as reported, authorizes a total of 14,755,200,000 for NASA, $4,517,000 for the OCST within DOT, and $1,363,000 for the National Space Council.

TITLE I.—NASA AUTHORIZATION

Of the $14,755,200,000 authorized for NASA, $6,804,000,000 is authorized for Research and Development, $5,189,400,000 for Space Flight, Control and Data Communications, $497,900,000 for Construction of Facilities, $2,252,900,000 for Research and Program Management, and $11,000,000 for the activities of the Inspector General's Office.

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION—NASA BUDGET SPREAD SHEET FOR FISCAL YEAR 1991

[In millions of dollars]

	Fiscal year—			
	1990 operating plan	1991 request	1991 proposed Senate authorization	Comment
I. Research and Development	5,227.7	7,074.0	6,804.0	
1. Space Station	1,749.6	2,451.0	2,381.0	Assumes general reduction of $50 M.
Development	1,661.2	2,299.8		
Flight Telerobic Services	79.4	106.3		
Advanced Programs	9.0	36.0	−20.0	Reduction to Space Exploration Initiative (SEI).

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION—NASA BUDGET SPREAD SHEET FOR FISCAL YEAR 1991—Continued

[In millions of dollars]

	Fiscal year—			
	1990 operating plan	1991 request	1991 proposed Senate authorization	Comment
Operations	(1)	8.9		
2. Space Transportation Capability Development.	558.2	773.4	673.4	
Spacelab Dev. and Ops	93.7	130.7		
Upper Stages Dev. and Ops	79.7	91.3		
Engineering and Tech. Base	181.6	218.5		
Payload Ops. and Sup. Equip	65.5	122.5		
Advanced Programs	34.7	53.2		
Advanced Transportation Tech.	(1)	53.9	−50.0	Reduction to Shuttle C and Ad. Launch Systems (SEI).
Tethered Satellite System	27.3	17.9		
Orbital Maneuvering System	75.7	85.4	−50.0	Reduction consistent with NASA termination of OMV.
3. Space Science	1,356.3	1,633.2	1,603.2	
A. Physics and Astronomy	859.4	985.0	985.0	
Global Geospace Science	57.6	98.5		
Advanced X-Ray Astrophysics Fac.	44.0	113.0		
Payload and Instrument Dev	93.0	97.2		
Shuttle/Spacelab Payload Mgt.	75.1	89.1		
Sp. Station Integrated Planning and Attached Payloads.	5.0	15.0		
Explorer Development	88.4	100.8		
Mission Operations and Data Analysis.	215.7	293.9		
Research and Analysis	104.9	122.5		
Suborbital Program	52.7	55.0		
B. Life Sciences	106.1	163.0	163.0	
C. Planetary Exploration	390.8	485.2	455.2	
Ulysses	14.3	3.3		
Mars Observer	98.9	68.9	−15.0	Reduction related to SEI.
CRAF/CASSINI	29.5	148.0		
Mars Balloon Relay	4.4	2.0		
Mission Ops & Data Analysis.	156.0	173.5		
Research and Analysis	70.6	89.5	−15.0	Reduction to Lunar Observer (SEI).
4. Earth Science	434.2	661.5	679.5	
Earth Observing System	(1)	103.0	+5.0	Assumes new start status for EOS in FY 1991. Increase for EOS Instrument program.
Polar Platform	74.0	132.0		
Earth Probes	(1)	25.0	+10.0	Increase for Total Ozone Mapping Spectrometer (TOMS).
Upper Atmosphere Res. Satellite (UARS).	55.2	66.0		
Ocean Topography (TOPEX)	84.8	68.0		
Scatterometer	13.6	3.7		
Payload and Instrument Dev.	76.1	49.7		

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION—NASA BUDGET SPREAD SHEET FOR FISCAL YEAR 1991—Continued

[In millions of dollars]

	Fiscal year—			
	1990 operating plan	1991 request	1991 proposed Senate authorization	Comment
Mission Ops and Data Analysis	23.9	30.4		
Interdisciplinary Research	8.6	2.4		
Modeling and Data Analysis	38.5	41.3	+3.0	Increase for Earth Science data directories and remote sensing data conversion.
Process Studies	106.2	111.1		
Laser Research Facilities	8.0	8.7		
Airborne Science and Applications	19.4	20.2		
5. Space Applications	207.8	186.9	186.9	
A. Materials Processing in Space	101.9	97.3	97.3	
B. Communications	77.7	52.8	52.8	
C. Information Systems	28.2	36.8	36.8	
6. Commercial Programs	56.5	101.0	101.0	
Technology Utilization	23.7	24.4		
Commercial Use of Space	32.8	76.6		
7. Aeronautics and Space Technology	800.6	1,163.9	1,075.9	
Aeronautical Research and Technology.	442.5	512.0		
Transatmospheric Research and Technology.	59.0	119.0		
Space Research and Technology	284.1	495.9	−88.0	Reduction to Exploration Technology programs (SEI).
Exploration Mission Studies	15.0	37.0		All Studies to be conducted by NASA.
8. Safety Reliability and Quality Assurance.	22.6	33.0	33.0	
9. Tracking and Data Advanced Systems.	19.4	20.0	20.0	
10. Academic Programs	37.5	50.1	50.1	
II. Space Flight Control and Data Communications.	4,625.7	5,289.4	5,189.4	General reduction of $100M.
1. Space Shuttle Production/Operations Capability.	1,195.0	1,302.0	1,302.0	
Orbiter Operational Capability	238.1	213.6		
Launch & Mission Support	283.1	265.5		
Propulsion Systems	673.8	822.9		
2. Space Transportation Operations	2,632.5	3,118.6	3,118.6	
Flight Operations	750.7	815.6		
Flight Hardware	1,201.0	1,467.2		
Launch & Landing Operations	541.0	606.6		
Expendable Launch Vehicles	139.8	229.2		
3. Space Tracking & Data Acquisition	798.2	868.8	868.8	
Space Network	321.8	331.2		
Ground Network	251.5	267.8		
Communications & Data Systems	224.9	269.8		
III. Construction of Facilities	411.0	497.9	497.9	

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION—NASA BUDGET SPREAD SHEET FOR FISCAL YEAR 1991—Continued

[In millions of dollars]

	Fiscal year—			
	1990 operating plan	1991 request	1991 proposed Senate authorization	Comment
IV. Research and Program Management	2,023.5	2,252.9	2,252.9	
V. Inspector General	8.7	11.0	11.0	
Total NASA	12,296.6	15,125.2	14,755.2	

[1] New line items proposed for fiscal year 1991.

Space Station

The reported bill provides $2,381,000,000 in FY 1991 for the Space Station Freedom. The bill assumes a reduction of $20,000,000 in Advanced Programs associated with the proposed Space Exploration Initiative, the President's proposal for human exploration of the Moon and Mars, as well as a general reduction of $50,000,000 to be applied at NASA's direction. While the funding level provided in the bill is slightly below the President's request, the reduced authorization is not expected to affect adversely NASA's current Space Station schedule for first element launch, man-tended capability, permanently manned capability, and assembly completion.

Space Transportation Capability

The Space Transportation Capability Development budget is $673,400,000 which is $100,000,000 below the President's FY 1991 budget request, but $115,200,000 above the NASA FY 1990 Operating Plan. This funding level will support continued development and operation of the Spacelab systems, procurement of upper stages required to place satellites in high altitude orbits, development and flight certification of the Tethered Satellite System, the engineering and technical base support at NASA centers, payload operations and support equipment, advanced transportation technology development activities, as well as other advanced programs.

The bill assumes a reduction of $40,000,000 for the Advanced Launch System (ALS), a joint NASA-Department of Defense (DOD) technology development program aimed at creating a new generation of low-cost unmanned launch systems. The $40,000,000 reduction to ALS corresponds to that portion of the FY 1991 budget request intended to accommodate potential launch requirements for the Space Exploration Initiative. The reported bill also assumes a $10,000,000 reduction for the heavy lift/Shuttle C vehicle studies, which are also associated with the proposed mission to the Moon and Mars. The reported bill also reduces the President's request by $50,000,000 to reflect cost savings that will result from NASA's recent termination of the Orbital Maneuvering Vehicle.

Space Science

For space science activities, including Physics and Astronomy, Life Sciences, and Planetary Exploration, the substitute authorizes $1,603,200,000 in FY 1991. This amount is $30,000,000 below the President's request, but $246,900,000 above NASA's FY 1990 Operating Plan.

The $985,000,000 provided for Physics and Astronomy will support on-going activities related to the development of the Advanced X-Ray Astrophysics Facility and the Global Geospace Science spacecraft, as well as a number of less complex Explorer spacecraft, Shuttle/Spacelab flights, and suborbital missions.

The $163,000,000 provided for Life Sciences equals the President's request for FY 1991. This represents a substantial increase over the FY 1990 Operating Plan of $106,300,000 and will enable NASA to understand better the effects of long-term human habitation in space, essential to the successful utilization of the Space Station and the extended duration orbiter.

The $455,200,000 provided in FY 1991 for Planetary Exploration will allow continued development of the Mars Observer, the joint NASA/European Space Agency Ulysses spacecraft, and the Comet Rendezvous Asteroid Flyby (CRAF) and Cassini missions. This amount is $30,000,000 below the President's budget request for FY 1991, reflecting the elimination of funds for the Lunar Observer and reduced funding for the Mars Observer program. This reduction is consistent with the Committee's intent to reduce funding for programs related to the proposed Space Exploration Initiative.

Earth Sciences

The reported bill includes $679,500,000 for Earth Science programs, including $108,000,000 for the Earth Observing System (EOS) and $35,000,000 for the Earth Probes program, both new starts in FY 1991. These initiatives are the cornerstone of NASA's Mission to Planet Earth, which is the agency's contribution to the U.S. Global Change Research Program. The bill assumes full funding of the President's request, with an additional $5,000,000 provided to expedite development of EOS instruments, $10,000,000 for the Total Ozone Mapping Spectrometer (TOMS) Earth Probe, $2,000,000 for initial development of an earth science data directory, and $1,000,000 to enable NASA to begin working with DOD and the intelligence community on converting military remote sensing data sets for use by the global change research community.

Space Applications

For space applications programs, including Materials Processing in Space, Communications, and Information Systems, the reported bill authorizes a total of $186,900,000 in FY 1991, an amount identical to the President's request. Within that amount, the substitute assumes $97,300,000 for Materials Processing, $36,800,000 for Information Systems, and $52,800,000 for Communications. The latter includes funds requested for continued development of the Advanced Communications Technology Satellite (ACTS).

Commercial Programs

The reported bill authorizes $101,000,000 in FY 1991 for Technology Utilization programs and the Commercial Use of Space. NASA's Technology Utilization program is designed to enhance opportunities for the transfer of space-based technologies to other sectors of the economy, while the Commercial Use of Space program is NASA's attempt to develop opportunities for private sector investment and involvement in civil space activities.

Aeronautics and Space Technology

The reported bill provides a total of $1,075,900,000 in FY 1991 for aeronautics and space technology programs, a reduction of $88,000,000 from the President's request. The bill fully funds the Aeronautical Research and Technology program at $512,000,000, as well as the budget request of $119,000,000 for the Transatmospheric Research and Technology program, a joint NASA/DOD program to develop the National Aerospace Plane (NASP).

The reported bill reduces funding for certain Space Research and Technology programs related to the Space Exploration Initiative, authorizing a total of $407,900,000 in FY 1991. While this is a reduction of $88,000,000 from the President's request, it represents an increase of $123,800,000 over NASA's FY 1990 Operating Plan. There is a critical need to understand better the issues related to the proposed Moon/Mars mission before providing funding to start the NASA research and technology development process in support of that mission. Accordingly, this reduction is directed at those programs supporting the Space Exploration Initiative, including vehicle technologies, space transportation, and in-space and surface operations. However, the reported bill fully funds the space research and technology base programs, realizing their importance to the future of other aspects of tne U.S. space program.

While supporting the concept of human exploration of the Moon and Mars, the Committee is concerned that in the current fiscal environment, the Federal government currently may not have the resources to initiate such a program. Human exploration of the Moon and Mars would be very costly in the near-term, requiring by NASA's estimates $444,000,000 in FY 1992 and $649,000,000 in FY 1993. NASA's budget would have to grow significantly—during a time of shrinking Federal budgets—to pay for a program that could cost several hundreds of billions of dollars over the next 30 years. In that regard, funding the Space Exploration Initiative in FY 1991 could be at the expense of other on-going programs, to which some 98 percent of the President's budget request is allocated.

The reported bill also fully funds the $37,000,000 requested for Mission Exploration studies. However, the bill stipulates that such studies are to be conducted solely by NASA.

Safety, Reliability, and Quality Assurance

The reported bill assumes full funding of the FY 1991 budget request for $33,000,000 for Safety, Reliability, and Quality Assurance programs, which are designed to reduce program risk throughout NASA.

Tracking and Data Advanced Systems

The reported bill assumes full funding in FY 1991 for Tracking and Data Advanced Systems at $20,000,000. Under this program, NASA is working to develop higher performance tracking and data handling capabilities in support of future missions.

Academic Programs

The reported bill funds the requested amount of $50,100,000 in FY 1991 for NASA's Academic programs, including the Space

Grant College and Fellowship program and a series of minority university research programs. The Committee believes NASA's efforts to broaden the participation of our Nation's educational institutions in the civil space program are very important.

Space Flight, Control, and Data Acquisitions

The reported bill authorizes a total of $5,189,000,000 in FY 1991 for Space Flight, Control, and Data Acquisition, including Space Shuttle Production and Operational Capability ($1,302,000,000); Space Transportation Operations ($3,118,600,000); and Space Tracking and Data Acquisition programs ($868,800,000).

The bill assumes a general reduction of $100,000,000 to the President's request for the Space Flight, Control, and Data Acquisition account in FY 1991. Nonetheless, the reported bill provides an increase for these programs of $633,700,000 over NASA's FY 1990 Operating Plan. This general reduction, which can be applied at NASA's discretion, should not be implemented in any way that could affect adversely the sustained operation of a safe and reliable Space Shuttle System.

The reported bill also includes a one-time authorization in FY 1991 of $1,209,732,000 to be used only for the purpose of reducing all outstanding debt on the Tracking and Data Relay Satellite System (TDRSS) to the Federal Financing Bank.

Construction of Facilities

The reported bill fully authorizes the budget request for Construction of Facilities (COF) in FY 1991, at $497,900,000. NASA has requested these funds to support construction, repair, and rehabilitation of facilities needed to support the civil space program. This amount is an increase of $86,900,000 over the FY 1990 NASA Operating Plan.

Research and Program Management

The reported bill authorizes full funding for Research and Program Management in FY 1991, at a level of $2,253,000,000. This funding will support all civil service staff, maintenance of facilities, and support of research and development programs and contract activities, as well as technical and administrative support of research and development programs. This amount represents an increase of $229,400,000 over NASA's FY 1990 Operating Plan.

Inspector General

The reported bill provides the requested level of $11,000,000 for activities of the Office of Inspector General.

Other Provisions

As has been the case with prior NASA authorization bills, the reported bill directs NASA to distribute research funds on a geographical basis where possible. It also directs that the Space Station may be used only for peaceful purposes. The bill also includes several provisions requested by the Administration establishing parameters on the use of funds provided under the Construction of Facilities program, the transfer of funds from one account to an-

other, and the use of funds for activities approved by the Committee.

TITLE II.—DOT AUTHORIZATION

The reported bill includes the FY 1991 authorization for the OCST in DOT in Title II. The substitute authorizes the President's request of $4,517,000 for FY 1991.

TITLE III.—NATIONAL SPACE COUNCIL AUTHORIZATION

The reported bill includes the FY 1991 authorization of the activities of the National Space Council. For FY 1991, $1,363,000 is provided, the full amount requested by the President.

ESTIMATED COSTS

In accordance with paragraph 11(a) of rule XXVI of the Standing Rules of the Senate and section 403 of the Congressional Budget Act of 1974, the Committee provides the following cost estimate, prepared by the Congressional Budget Office.

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, DC, July 18, 1990.

Hon. ERNEST F. HOLLINGS,
Chairman, Committee on Commerce, Science and Transportation, U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the attached cost estimate for S. 2287, the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1991.

If you wish further details on this estimate, we will be pleased to provide them.

Sincerely,

ROBERT D. REISCHAUER, *Director.*

CONGRESSIONAL BUDGET OFFICE—COST ESTIMATE

1. Bill number: S. 2287.
2. Bill title: National Aeronautics and Space Administration Authorization Act, Fiscal Year 1991.
3. Bill status: As ordered reported by the Senate Committee on Commerce, Science, and Transportation, June 27, 1990.
4. Bill purpose: S. 2287 would authorize fiscal year 1991 appropriations to the National Aeronautics and Space Administration (NASA), the Office of Commercial Space Transportation in the Department of Transportation, and the National Space Council in the Executive Office of the President.
5. Estimated cost to the Federal Government:

[By fiscal year, in millions of dollars]

Authorization of appropriations	1991	1992	1993	1994	1995
NASA:					
Total authorization	15,965				
Portion applied to debt reduction	−1,210				
Net authorization-NASA	14,755				

[By fiscal year, in millions of dollars]

Authorization of appropriations	1991	1992	1993	1994	1995
OCST	5				
National Space Council	1				
Total authorization	14,761				
Estimated outlays	9,089	4,450	990	208	24

The costs of this bill would be in budget functions 250, 400, and 800.

The fiscal year 1990 appropriation for NASA is $12.3 billion, and the President has requested $15.1 billion for fiscal year 1991; these figures correspond to the net authorization of $14.8 billion in the table above. Including outlays from prior year appropriations, total outlays for NASA would be $13.9 billion in fiscal year 1991 if the full amount authorized were appropriated.

Basis of estimate: For this estimate, we have assumed that the full amounts authorized would be appropriated for fiscal year 1991 and that $1.2 billion of the amount provided to NASA would be used to reduce outstanding debt with the Federal Financing Bank, as is specified in the bill. The estimated outlays are based on historical spending patterns. Detailed estimates for NASA programs are shown in the table below.

AUTHORIZATIONS FOR NASA PROGRAMS PROVIDED BY S. 2287

[By fiscal year, in millions of dollars]

	1991	1992	1993	1994	1995
Research and development:					
Authorization level	$6,804				
Estimated outlays	3,502	$2,495	$649	$158	
Space flight, control and data communications:					
Authorization level	6,399				
Portion applied to debt reduction	−1,210				
Net authorization	5,189				
Estimated outlays	3,591	1,382	216		
Construction of facilities:					
Authorization level	498				
Estimated outlays	50	249	124	50	$25
Research and program management:					
Authorization level	2,253				
Estimated outlays	1,933	320			
Office of the Inspector General:					
Authorization level	11				
Estimated outlays	9	2			
Total, NASA authorizations:					
Authorization level	15,965				
Portion applied to debt reduction	−1,210				
Net authorization	14,755				
Estimated outlays	9,085	4,447	990	208	25

6. Estimated cost to State and local governments: None.
7. Estimate comparison: None.
8. Previous CBO estimate: None.
9. Estimate prepared by: Michael Sieverts (226-2860).
10. Estimate approved by: James L. Blum, Assistant Director for Budget Analysis.

Regulatory Impact Statement

In accordance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the Committee provides the following evaluation of the regulatory impact of the legislation.

Title I of this bill authorizes the appropriation of $14,755,200,000 in FY 1991 for the conduct of space and aeronautical research and development activities to carry out the policy and purpose of the National Aeronautics and Space Act of 1958. These activities are conducted in NASA laboratories, by NASA personnel and through contracts with industry, universities, and research institutions for research and development, and for supporting scientific and technical services. The Committee believes that Title I, which extends funding authority for existing NASA programs, will not increase the paperwork burden for any individual or business, nor will it have a significant effect on individual privacy.

Title II of the bill authorizes the appropriation of funds for the OCST at DOT. This office licenses and regulates the commercial expendable launch vehicle industry in order to protect the public health and safety, and ensure compliance with existing U.S. treaty and international obligations. This office was created to reduce the regulatory burden and paperwork requirements on the industry. The reported bill extends funding authority for existing programs.

Title III of the bill authorizes the appropriation of funds for the National Space Council. The Council was created to provide a high level office dedicated to the formulation of space policy. A key role of the Council is to assist in reducing the regulatory burden of commercial space firms trying to market their services to the U.S. Government and to compete in foreign markets.

In total, the Committee believes that the reported bill should not increase existing regulation, should not have an adverse impact on individual privacy, and should not increase the paperwork requirement for any individual or businesses choosing to participate in the space program. While the bill authorizes an increase in funds for these space agencies, it is not expected to have a significant additional impact on the national economy.

Section-by-Section Analysis

SECTION 1.—SHORT TITLE

Section 1 states that the short title of this bill is the "National Aeronautics and Space Administration Authorization Act, Fiscal Year 1991."

TITLE I—FISCAL YEAR 1991 NASA AUTHORIZATION

SECTION 101.—NASA AUTHORIZATION

Section 101 of the bill authorizes appropriations for NASA for FY 1991.

Research and Development

Section 101(a) authorizes appropriations to NASA to become available October 1, 1990 for "research and development". This subsection authorizes a total of $6,804,000,000 for space station; space transportation capability development; physics and astronomy; life sciences; planetary exploration; earth sciences; space applications; technology utilization; commercial use of space; aeronautic research and technology; transatmospheric research and technology; space research and technology; exploration mission studies; safety, reliability, and quality assurance; tracking and data advanced systems; and academic programs.

In total, the reported bill authorizes a total of $6,804,000,000 for NASA's Research and Development programs. This is $270,000,000 below the President's FY 1991 budget request, but is an increase of $1,576,300,000 above NASA's FY 1990 Operating Plan, an increase of more than 23 percent.

Discussion of Specific Authorizations

Space Station.—The bill authorizes $2,381,000,000 for the Space Station Freedom program. This is $70,000,000 below the President's budget request, and includes the deletion of $20,000,000 requested for Advanced Programs to support the proposed Space Exploration Initiative, and a general reduction of $50,000,000, to be applied at NASA's discretion.

Summary of fiscal year 1991 funding levels

Development	$2,299,800,000
Flight telerobotic services	106,300,000
Operations	8,900,000
Advanced programs	16,000,000
Total	[1] 2,381,000,000

[1] Total reflects a general reduction of $50,000,000 to be applied at NASA's discretion.

Development of the U.S. permanently manned Space Station will add new momentum to the civil space program and is essential to preserving U.S. preeminence in science, technology, and manned space flight. The Space Station Freedom program provides the Nation with its first opportunity to gain direct experience with long-term human operations in space and knowledge essential to future space exploration. The Space Station will enhance uniquely the U.S. space science programs, further the commercial utilization of space, and stimulate the development and application of advanced technologies of national importance. It is also the centerpiece of cooperation with our international partners, demonstrating the peaceful use of space for the benefit of all mankind.

The Space Station Freedom will provide the United States with a permanently manned presence in space and is designed to accommodate diverse capabilities. This diversity is reflected in the Space

Station's design, which features pressurized laboratories and accommodations for attached payloads. This new national laboratory, a research center in space, will stimulate new technologies, enhance industrial competitiveness, further commercial space enterprises, and add greatly to our storehouse of scientific knowledge. Perhaps the most significant feature of the Space Station, essential to its utility for science, commerce, and technology, is the continuing presence of its crews. Men and women will be aboard the Space Station base full-time. The potential of humans—their resourcefulness and creativity—is unique and essential. The Space Station will be designed to exploit these human capabilities. The Space Station's microgravity environment and extended time in orbit will enable scientists to make new discoveries in materials research and life sciences. The Space Station's substantive research capabilities include far more than its pressurized volume. Moreover, the Space Station's external structure is designed to be a stable platform that will be available for mounting a number of specialized instruments and telescopes. Scientific instruments, whether in a laboratory or on a boom, require maintenance, upgrading, repair, and replacement. The Space Station will make extensive use of telerobotics to meet these requirements. It will be designed to evolve, to be capable of growth in its capabilities, so that future needs and challenges can be met.

The Space Station Freedom will be a multi-purpose, international facility. In 1984, President Reagan invited the full participation of other nations. During the ensuing definition phase, Canada, the member countries of the European Space Agency (ESA), and Japan worked closely with the United States to define their participation. These parallel definition and preliminary design studies have resulted in the identification of the Space Station elements to be developed by the Nation's partners. Negotiations with these international partners for the development phase of the program were completed in 1988. Agreements have been signed with the Canadian government for the development of a mobile servicing system, with the member countries of ESA for the inclusion of a pressurized attached module, a man-tended free flyer, and a polar platform, and with the Japanese government for the development of an attached laboratory module.

Space Station—Committee Comments

The Committee continues to strongly endorse the development of a permanently manned space station in cooperation with our international partners. The reported bill, which provides for an increase of more than $631,000,000 over NASA's FY 1990 Operating Plan, reflects this strong support.

As in previous years, however, the Committee is concerned about the current outlook for the Federal budget and how it will affect this recommended funding increase for the Space Station Freedom. In recognition of the constraints likely to be imposed on domestic discretionary spending in FY 1991, the Committee has recommended a general reduction to the Space Station program of $50,000,000. Funding below the level in the reported bill should be avoided because significant reductions could delay the schedule milestones

currently established for the Space Station Freedom: first element launch (1995), man-tended capability (1996), permanently manned capability (1997), and assembly completion (1999). In addition, significant funding reductions in FY 1991 likely will increase the total cost to complete the Space Station.

Congress and the President must agree that the Space Station Freedom is a national priority to ensure that necessary funds are provided to keep this project on schedule. Such an agreement is critical to our future working relationships with Canada, Japan, and ESA. These nations have committed a total of $7.2 billion to the Space Station Freedom and must be considered by NASA and the U.S. Government to be major partners in the project. Significant funding reductions or the termination of the Space Station program could affect adversely U.S. foreign policy and hinder future international cooperative civil space activities.

Consistent with the Committee's decision to terminate all funds associated with the President's Space Exploration Initiative, the $20,000,000 requested in Space Station Advanced Programs to support human exploration of the Moon and Mars has not been included in the bill. Such a reduction is intended to help ensure that NASA and the Administration remain focused on completing the Space Station Freedom, rather than shifting scarce resources to other projects that could hinder its development.

Throughout FY 1990, NASA is conducting more than 80 subsystem Preliminary Design Reviews (PDRs) of the Space Station components, leading to the system-level PDR, now scheduled for December, 1990. This is a critical phase in the development of Space Station Freedom, as there are a number of key issues relating to its design that remain unresolved. Following the PDR, the Space Station is scheduled for a Critical Design Review in 1993, to be followed by fabrication of actual space hardware.

The number of major open items affecting the design of the Space Station that could be impediments to further development of the facility is cause for concern. Foremost of these is the amount of external maintenance required in the early years of the Space Station's development and operation. A NASA task force has determined that without design changes, nearly 3,300 hours of extravehicular activities (EVAs) a year will be required by the astronauts to make repairs and maintain the facility. A second task force has evaluated these external maintenance requirements and has made recommendations which, if implemented, are expected to mitigate significantly EVA requirements. Design changes required to reduce the number of annual EVA hours to an acceptable level may be very costly, cause delays in the Space Station schedule, or reduce the content of the mission. As such, the Committee intends to monitor carefully progress in this area during the PDR process. In light of the estimated excessive number of Space Station EVAs, the Committee fully endorses continued development of the Flight Telerobotic Servicer (FTS), as well as other robotics that could minimize substantially time-consuming and risky astronaut EVA.

Equally important is whether the Space Station can be designed to meet currently baselined weight and power requirements. The current baseline weight level for Space Station Freedom is 512,000 pounds. NASA recently announced that weight requirements in

three of the four Space Station work packages have increased substantially, causing the total weight to exceed 620,000 pounds. Unless reduced, this weight increase will have a significant impact on the number of Space Shuttle flights needed to assemble and supply the Space Station, and a result, increase the time needed to achieve permanently-manned capability and assembly completion. With respect to power, there is concern that of the 75 kilowatts to be generated by Space Station Freedom, the amount available for scientific experiments continues to be reduced as housekeeping needs escalate. Adequate power allocation for scientific users is essential if the Space Station is to perform its basic function as an international space-based laboratory.

The Committee maintains its belief that the Space Station should be used for peaceful purposes in accordance with international law. Accordingly, the Committee has incorporated language in section 106 of the bill which affirms this position.

Space Transportation Capability Development.—The bill authorizes $673,400,000 for Space Transportation Capability Development in FY 1991. This is $100,000,000 below the President's budget request.

Summary of fiscal year 1991 funding levels

Spacelab	$130,700,000
Upper stages	91,300,000
Engineering and technical base	218,500,000
Payload operations and support equipment	122,500,000
Advanced programs	53,200,000
Advanced transportation technology	3,900,000
Tethered satellite system	17,900,000
Orbital maneuvering vehicle	35,400,000
Total	673,400,000

The principal areas of activity in Space Transportation Capability Development include the Spacelab systems and related development activities; procurement of Upper Stages required to place satellites in high altitude orbits; the Engineering and Technical Base support at the manned space flight centers; Payload Operations and Support Equipment for accommodating NASA payloads; Advanced Programs study and evaluation efforts; ALS efforts; and the design and development of the United States/Italian Tethered Satellite System.

Space Transportation Capability Development—Committee Comments

The Committee has reduced the President's request by a total of $100,000,000 in FY 1991. Of that amount, the bill assumes a reduction of $40,000,000 to the joint NASA/DOD ALS program, $10,000,000 for heavy launch vehicle studies focused on the development of the unmanned Shuttle-C, and $50,000,000 to reflect cost savings associated with NASA's recent termination of the Orbital Maneuvering Vehicle.

The Committee's decision to eliminate funds requested for the ALS propulsion and heavy lift/Shuttle-C studies is consistent with the Committee's termination of funds requested to support the President's proposed Space Exploration Initiative to the Moon and

Mars. Without a mission requiring heavy lift launch capability, such as human exploration of the Moon or Mars, there is a reduced current need in the U.S. civil space program for either ALS or Shuttle C. Other launch requirements for ALS are driven by the Air Force and the Space Defense Initiative (SDI) program. NASA has concluded that with the Advanced Solid Rocket Motor, which is expected to be baselined into the Space Station program in the near future, development of the Shuttle C cannot be justified solely on the basis flights needed to assemble or supply the Space Station Freedom. Accordingly, without another accepted mission requirement for such heavy lift launch technology, the Committee has deleted the $10,000,000 requested to support Shuttle C/heavy lift studies.

The Committee also has reduced the FY 1991 authorization for the Orbital Maneuvering Vehicle to $35,400,000 to reflect NASA's recent decision to terminate that program. This is a reduction of $50,000,000 in FY 1991. The amount provided for the coming fiscal year, along with a carryover of approximately $30,000,000 in unobligated funds from FY 1990, should be adequate for the negotiated contractor termination payments.

Physics and Astronomy.—The Committee authorizes $985,000,000 for Physics and Astronomy in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Global geospace science	$98,500,000
Advanced x-ray astrophysics facility development (AXAF)	113,000,000
Payload and instrument development	97,200,000
Shuttle/Spacelab payload mission management and integration	89,100,000
Space station integrated planning and attached payloads	15,000,000
Explorer development	100,800,000
Mission operation and data analysis	293,900,000
Research and analysis	122,500,000
Suborbital program	55,000,000
Total	985,000,000

The objectives of the Physics and Astronomy program are to increase the Nation's understanding of the origin and evolution of the universe, the fundamental laws of physics, and the formation of stars and planets. Objects studied by the Astrophysics program include distant galaxies and galactic clusters, as well as stars and other structures in nearby galaxies and the interstellar medium in the galaxy. Unusual and exotic phenomena—such as quasars, neutron stars, pulsars and black holes—are of particular interest to the Astrophysics program, and are the target of many ground-based and space-based research programs. In the Space Physics program, intensive study of the Sun, with its multitude of time-varying phenomena, provides key answers to a vast range of questions requiring comprehensive research into polar-terrestrial processes and the physics and coupling between the solar wind, magnetosphere, ionosphere, and atmosphere.

The objectives of the Physics and Astronomy program are accomplished with a mixture of large, complex, free-flying space missions, less complex Explorer spacecraft, Shuttle/Spacelab flights, and suborbital opportunities. In the future, the Space Station Freedom will act as a platform for attached payloads. Space-based research

allows observations in the infrared or the ultraviolet wavelengths which are unobtainable on the ground due to the obscuring effects of the atmosphere. Also, observations in the visible light region are vastly improved when conducted above the atmosphere. The entire program rests on a solid basis of supporting research and technology, data analysis, and theory.

Research teams involved in this program are located at universities, industrial laboratories, NASA field centers, and other government laboratories. The scientific information obtained and the technology developed in this program are made available to the scientific communities and the general public for application to the advancement of scientific knowledge, education, and technology.

Physics and Astronomy—Committee Comments

In June, 1990, NASA reported that the Hubble Space Telescope contained an apparent flaw in its optical systems which would preclude much of the planned scientific work. Launched on April 24, 1990, after 12 years and $1,500,000,000 in design and development costs, the Hubble was expected to provide resolution 7 to 10 times greater than images from Earth-based telescopes. However, because of what appears to be a spherical aberration in the primary mirror that was not detected prior to launch, the Space Telescope's capabilities in the visible light range will be limited severely until a planned 1993 Shuttle servicing mission can install new instruments that will compensate for the error.

NASA acted quickly to appoint a group of experts under the direction of Dr. Lew Allen, Director, Jet Propulsion Laboratory, to determine the exact cause of Hubble's optical flaw. Testimony received in the Committee oversight hearings revealed a vast array of management problems at NASA in the late 1970s and early 1980s, any number of which could prove to be the cause of the optical flaw. However, the error could have, and should have, been detected had proper testing and quality assurance procedures been in place and adhered to by NASA and outside contractors. Because its the strong interest in rectifying the current problems with Hubble, the Committee will continue its close oversight of the NASA investigation during the coming months.

The Committee notes that the testing and quality assurance difficulties that existed at NASA during the time of the development of the Hubble Space Telescope are being addressed by NASA's current management team. Such improvements should enhance the prospects for success of future missions.

While the Committee remains disappointed with launch delays with the Astro-1 mission, caused by hydrogen fuel leaks in the Space Shuttle Columbia, there is strong support for the ambitious Physics and Astronomy mission agenda for the remainder of FY 1990 and FY 1991. In addition to the expected launch of the Gamma Ray Observatory, ongoing activities in the Explorer program, the Global Geospace Science program, and the Advanced X-ray Astrophysics Facility (AXAF) point to future accomplishments in this program area. Finally, the Committee continues to endorse the strategic planning efforts of the Office of Space Science and Applications for Physics and Astronomy programs.

Life Sciences.—The Committee authorizes $163,000,000 for Life Sciences in FY 1991, which is the same as the President's request.

Summary of fiscal year 1991 funding levels

Human space flight and systems engineering	$71,000,000
Space biological sciences	32,000,000
Search for extraterrestrial intelligence	12,100,000
Research and analysis	47,900,000
Total	163,000,000

The two major goals of the Space Life Sciences program are to develop medical and biological systems which enable human habitation in space and to advance the knowledge about the life processes of the universe. Results from the research program are applied to: (1) the immediate needs of maintaining astronaut health and productivity; (2) understanding of the response of biological mechanisms to weightlessness; (3) the development of environmental health requirements for space flight and design of controlled and bioregenerative life support systems; (4) understanding of the origin, evolution, and distribution of life in the universe; and (5) understanding of the biosphere of the planet Earth.

Continuation of support for the Space Life Sciences program is essential: (1) to understand the basic biological mechanisms of responses to gravitational forces; (2) to evolve the critical technologies necessary to enable long-term, piloted space flight; and (3) to develop the capability to sustain a permanent manned presence in space. The research program studies fundamental biological processes through both ground-based and space research efforts which are mutually supportive and integrated.

Life Sciences—Committee Comments

The bill includes NASA's proposed increase for Life Sciences in FY 1991. As the United States continues toward the objective of a permanently-manned Space Station in 1991, there is a need to better understand the effects of long duration space flights on the human body. It is therefore essential the NASA has a comprehensive life sciences program, which is reflected in the bill.

Planetary Exploration.—The bill authorizes $455,200,000 for Planetary Exploration in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Ulysses	$3,300,000
Mars Observer	53,900,000
Mars balloon relay	2,000,000
Comet Rendezvous Asteroid Flyby (CRAF)/Cassini	148,000,000
Mission operations and data analysis	173,500,000
Research and analysis	74,500,000
Total	455,200,000

The Planetary Exploration program encompasses the scientific exploration of the solar system, including the planets and their satellites, comets and asteroids, and the interplanetary medium. The program objectives are: (1) to determine the nature of planets, comets, and asteroids as a means of understanding the origin and evolution of the solar system; (2) to understand better the Earth

through comparative studies with the other planets; (3) to understand how the appearance of life in the solar system is related to the chemical history of the solar system; and (4) to provide a scientific basis for the future use of resources available in near-Earth space. Projects undertaken in the past have been highly successful based on a strategy that places a balanced emphasis on the Earth-like inner planets, the giant gaseous outer planets, and the smaller bodies (comets and asteroids). Missions to these bodies start at the level of reconnaissance to achieve a fundamental characterization of the bodies, and then proceed to levels of more detailed study.

The reconnaissance phase of inner planet exploration, which began in the 1960s, is now virtually completed, although there still is little known about the nature of the planet Venus' surface. Mars has provided program focus because of its potential as a site of biological activity. The Viking landings in 1976 carried the exploration of Mars forward to a high level of scientific and technological achievement, thereby setting the stage for the next step of detailed study. Analyses of meteorites and the lunar rock samples returned by Apollo continue to be highly productive, producing new insights into the early history of the inner solar system and thus leading to a revision of the previous theoretical concepts. The Pioneer Venus mission is continuing to carry the study of the Earth's nearest planetary neighbor and closest planetary analog beyond the reconnaissance stage to the point of obtaining a basic characterization of Venus' thick, massive atmosphere, as well as fundamental data about the formation of the planet.

The exploration of the giant outer planets began more recently. The Pioneer-10 and -11 missions to Jupiter in 1973 and 1974 were followed by the Voyager-1 and -2 spacecraft encounters with Jupiter in 1979. Voyager-1 then encountered Saturn in November 1980, and Voyager-2 encountered Saturn in August 1981. The Voyager data on these planets, their satellites, and their rings have revolutionized the concepts about the formation and evolution of the solar system. Voyager-2 encountered Uranus in January 1986 and has provided the first look at this giant outer planet. Its trajectory carried it to an encounter with the planet Neptune in August, 1989 and provided spectacular images of this mysterious planet and its satellites. The Pioneer-10 and -11 and Voyager-1 spacecraft are on trajectories heading out of the solar system as they continue to return scientific data about the outer reaches of the solar system.

Planetary Exploration—Committee Comments

The bill authorizes full funding in FY 1991 in support of NASA's ambitious Planetary Exploration program. The scheduled October, 1990 launch of Ulysses, which will carry a package of instruments to the Sun, the Mars Observer, to be launched in 1992, the Comet Rendezvous Asteroid Flyby (CRAF), and the Cassini mission to Saturn and Titan, are the next phases of a planetary program that will be a source of significant scientific data and information in the years to come.

The Committee has reduced the FY 1991 authorization for the Mars Observer and the Lunar Observer each by $15,000,000 in the reported bill. This is the amount assigned to each mission by

NASA in the President's FY 1991 budget as a part of the proposed Space Exploration Initiative. This reduction is consistent with the Committee's intent not to fund those parts of the NASA budget request in the next fiscal year that support human exploration of the Moon or Mars.

Earth Sciences.—The bill authorizes $679,500,000 for Earth Sciences in FY 1991. This is $18,000,000 more than the President's budget request. To highlight these programs, the bill also establishes Earth Sciences as a new line item in the NASA budget. Of the $679,500,000 authorized for Earth Sciences programs, $108,000,000 is authorized only for EOS.

Summary of fiscal year 1991 funding levels

Earth Observing System (EOS)	$108,000,000
Polar Platform	132,000,000
Earth Probes	35,000,000
Upper atmos. res. satellite (UARS)	66,000,000
Ocean topography experiment (TOPEX)	68,000,000
Scatterometer	3,700,000
Payload and instrument development	49,700,000
Mission operations & data analysis	30,400,000
Interdisciplinary research	2,400,000
Modelling and data analysis	44,300,000
Process studies	111,100,000
Laser research facilities	8,700,000
Airborne science and applications	20,200,000
Total	679,500,000

The specific objectives of the Earth Science program are to improve understanding of the processes in the atmosphere, oceans, land surface and interior of the Earth and advance knowledge of the interactions among these environments. The program will provide space observations of parameters involved in these processes and extends the national capabilities to predict environmental phenomena, both short- and long-term, and their interaction with human activities. Because many of these phenomena are global or regional, they can be most effectively, and sometimes only, observed from space. NASA's programs include scientific research efforts, as well as the development of new technology for global and synoptic measurements. NASA's research satellites, Shuttle/Spacelab payload program, and Airborne Science and Applications program provide a unique view of the planet Earth, its physical dynamics, and radiative and chemical processes which affect habitability and the solar-terrestrial environment.

Several significant objectives have been established for the next decade of this program. These include advancing the understanding of the upper atmosphere through the determination of the spatial and temporal distribution of ozone and select nitrogen, hydrogen, and chlorine species in the upper atmosphere and their sources in the lower atmosphere; characterizing the current state of the terrestrial landscape, including the biosphere and the hydrosphere; optimizing the use of space-derived measurements in understanding large-scale weather patterns; advancing the knowledge of severe storms and forecasting capabilities, ocean productivity, circulation, and air-sea interactions; and improving the knowledge of seasonal climate variability leading to a long-term strategy for cli-

mate observation and prediction. Studies of the cycling of key biogeochemical elements, interactions between the biosphere and the climate system, the composition and evolution of the Earth's crust and the processes that shape the Earth's crust are essential to the understanding of the global environment.

The on-going NASA program is making critical near-term contributions to understanding the Earth as an integrated system as well as to environmental issues, including global warming and ozone depletion. NASA's base program combines ground-based measurements, laboratory studies, data analysis, and model development with a progressive series of satellite missions, contributing to the scientific research base in ozone monitoring, ocean circulation, and atmospheric chemistry. All these programs are precursors to "Mission to Planet Earth," the first major element of which is EOS.

EOS will serve as the science research centerpiece of NASA's global change program and will document the extent and causes of global change and observe regional-to-global scale processes. Utilizing a diverse but balanced suite of instruments, two series of three polar orbiting platforms (six spacecraft in total), along with European and Japanese polar platforms, will document global change over a 15-year period to provide long-term, consistent data sets. Each EOS platform will have a five-year design life. Each series will have a different, but complimentary focus: EOS–A will focus largely on land mass observations, such as vegetation, deforestation, and soil moisture; and the EOS–B platform will concentrate on ocean circulation and atmospheric chemistry.

The ability to measure the extent of both the natural and man-induced changes in the global ecosystem in only a preliminary step—the capability to model and predict the consequences of global change is the ultimate objective. The EOS data collection process and modeling research effort will provide the basis for establishing predictive global change models which can assist in formulating strategies to manage the human impact on global processes such as the greenhouse effect, ozone depletion, and deforestation of the rain forests. In order to provide a focused and effective mechanism for coordinating and directing federally-funded Earth science research, the U.S. Global Change Research Program was initiated in early 1989, in which NASA has been a major participant.

There are currently 10 terabytes of Earth Sciences data managed by Federal agencies in the United States. Of that, an increasing amount is at risk of being lost. Accordingly, a priority for the Global Change Research Program is the development of a data network capable of processing, archiving and distributing that data. That need will grow acutely as the volume of data is projected to increase a thousand-fold even without EOS; EOS is then expected to double the total amount of Earth Science data in one year. The EOS Data and Information System (EOSDIS) is intended to accomplish this task, and to ensure access to interagency and international computer networks and systems that will link it to the entire global change research community. EOSDIS will be developed by building on the existing data and information infrastructure within the research community.

A second component of NASA's Mission to Planet Earth, the Earth Probes, will provide an explorer-class program to address specific, highly-focused problems in Earth Science. Planned Earth Probes include platforms such as TOMS, intended to fly in 1991 to make observations of ozone layer depletion, the Ocean Topography Experiment (TOPEX) to study ocean circulation, and the Tropical Rainfall Measuring Mission (TRMM).

Earth Sciences—Committee Comments

Of the authorized amount, $108,000,000 is provided solely for EOS, which is approved as a new start in FY 1991, and $35,000,000 for the Earth Probes, which also is given new start status in FY 1991. The Committee supports initiation of both EOS and the Earth Probes.

Both programs are expected to increase dramatically our understanding of world environmental systems and global change. In light of growing world interest in these issues, a comprehensive, international study aimed at understanding Earth and the changes which are occurring must be a high priority for NASA in the coming decade. The reported bill is designed to initiate that effort.

The guiding principle behind NASA's Mission to Planet Earth is an integrated approach to observing Earth and determining how its various components function, interact, and have evolved over time. Eventually, such an approach will provide the capability to predict changes that might occur—either naturally or as the result of human activity. Because of the Committee's support for this initiative and interest in expediting EOS and the Earth Probes programs, an additional $5,000,000 has been provided in the bill above the President's budget for expedited development of EOS instruments, with another $10,000,000 authorized above the budget request for the TOMS Earth Probe.

The proposed integrated system endorsed by the bill would establish and maintain a global observation system of space platforms in a variety of Earth orbits, coordinated with ground-based measurements. The data from all of these observations would be integrated by a versatile, state-of-the-art information management system. EOSDIS will be the critical component to NASA's Earth Science program, for it will provide the avenue by which the science community is able to access data for research on the environment and global change. In this regard, the Committee notes that NASA has stated its intent to commit at least 60 percent of total EOS funding for EOSDIS development. Traditionally, space hardware has received the majority of available resources, limiting funding for processing, archiving, and distributing the data collected from those space platforms.

There are concerns about the size, cost, and complexity of EOS as it has been proposed. Further, there are concerns about the number and configuration of instruments to be flown on the EOS space platforms. These are issues that the Committee intends to review carefully in the coming months. They must be resolved in the early stages of EOS development, to ensure that before the first platform is launched in 1997, there is no uncertainty about program design or structure. As a part of its review, the Committee

looks forward to completion of the National Academy of Sciences' review of the Mission to Planet Earth and EOS, which is scheduled to be released later this year.

Notwithstanding the significant base of support for Mission to Planet Earth and EOS, NASA and the science community should understand that cost containment will be a critical element of this program and that NASA's ability to manage cost growth will be a critical factor in determining the ultimate scope of this program.

With respect to data storage, a March 1990 General Accounting Office (GAO) report concluded that "NASA is not properly safeguarding valuable data from past missions" and that "hundreds of thousands of tapes containing space science data are stored under deplorable conditions." Too often data management has been a very low priority at NASA. As a consequence, valuable data on global climate change, planetary science, solar physics, and other fields have gone unused because researchers are unable to locate or access it.

However, NASA's recent efforts to address these problems are encouraging. A Master Directory listing NASA's data sets has been created. This is essential if researchers are to locate the data they need and if NASA is to identify and preserve data which may otherwise be lost. The NASA Master Directory is available over computer networks to researchers throughout the country. It provides information on space and Earth science data sets (including calibration, type of instrument, inherent problems) and how to access them. The reported bill provides $2,000,000 to expand such efforts to locate, catalog, and provide access to NASA data sets.

Finally, there is a substantial wealth of existing data of potential interest for global change research that has been collected by classified remote sensing systems. The Committee has surveyed information from DoD and the intelligence communities and, because of the wealth of archived information, is convinced that arrangements could be made to convert much of that data to civilian use for global change research. To begin that process, the bill authorizes $1,000,000 for NASA in FY 1991.

Materials Processing.—The Committee authorizes $97,300,000 for Materials Processing in FY 1991. This is same as the President's budget request.

Summary of fiscal year 1991 funding levels

Research and analysis	$13,700,000
Materials experiment operations	79,900,000
Commercial microgravity R&D enhancements	3,700,000
Total	97,300,000

The Microgravity Science and Applications program uses the unique attributes of the space environment to conduct research in three primary areas: (1) Fundamental Science, which includes the study of the behavior of fluids, transport phenomena, condensed matter physics, and combustion science; (2) Materials Science, which includes electronic and photonic material, metals, alloys, glasses, and ceramics; and (3) Biotechnology, which focuses on micromolecular crystal growth and cell science. Goals of the program include developing a comprehensive research program in these

areas, as well as developing a structured understanding of gravity-dependent physical phenomena. This understanding will provide the basis for a reliable predictive capability for processing operations and technology issues in both Earth and non-Earth orbits. In FY 1991, ground-based research and payload development will support these program goals.

Materials Processing—Committee Comments

The Committee continues to be supportive of the Materials Processing program and believes that the long-term return from this program will be substantial. This program is a necessary precursor to the technological and commercial exploitation of the microgravity environment. For this reason, the bill authorizes the full budget request for materials processing in space for FY 1991.

Communications.—The bill authorizes $52,800,000 for Communications in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Advanced communications technology satellite (ACTS)	$34,000,000
Advanced communications research	12,500,000
Search and rescue	1,400,000
Radio science and support studies	3,300,000
Communications data analysis	1,600,000
Total	52,800,000

The ACTS program will develop advanced technologies for use in a joint experiments program in conjunction with U.S. industry to prove the utility of on-board switching (the baseband processor) and simultaneous communications transmissions to different terrestrial locations through an intricate multibeam antenna.

Advanced communciations research continues to provide the development of subsystem component technology required by NASA, other government agencies, and U.S. industry for advanced communications satellite systems. Special emphasis is being given to technologies with high potential for improving spectrum utilization, satellite switching, and intersatellite link technologies, since these technologies are the key to future growth of the communication satellite and terminal markets. An example of the technologies under study is optical space communications, which will improve extensively space communications capabilities. The mobile communications technology program has completed development of enabling technologies and is now ensuring the use of the technology by the private sector.

The Search and Rescue program is an international cooperative program that has demonstrated the use of satellite technology to detect and locate aircraft or vessels in distress. The United States, Canada, France, and the Soviet Union developed the system in which Norway, the United Kingdom, Bulgaria, Sweden, Demark, Switzerland, Brazil, and India also participate.

Radio science and support studies provide the technical basis to support U.S. and NASA interests in international and domestic communications regulatory forums. Propagation studies and measurements are performed in order to understand and account for

the effects of propagation in the design and specification of space communications systems. Studies to enable new satellite applications are conducted.

Communications data analysis assists other federal agencies and public sector organizations in the development of experimental satellite communications for emergency, disaster, and public service applications. The main areas of work will be preparation for future optical communications experiments and operation of the Applications Technology Satellite (ATS-3), launched in 1967.

Communications—Committee Comments

The ACTS program is critical to the future of the United States in the world communications market. Pioneering ACTS technology will provide capabilities qualitatively different from those of current satellite and fiber optic systems—such as on-demand assignment, frequency reuse, and flexible targeting of spotbeams. At a time when this country suffers from an adverse balance of trade and the Europeans and Japanese are mounting substantial threats to its share of the international communications market, ACTS allows the Federal government and the private sector to share the high costs and risks associated with the development of new technologies. The ACTS program is patterned on such a cooperative venture and represents a conscious effort to sustain the Nation's leadership in communications.

The Administration has reversed its opposition of previous years to this program and requested funds for the ACTS program in the FY 1991 budget. The Committee fully funds this request to support integration and test of the ACTS flight and ground systems, environmental tests of the flight system, and final preparations for shipment of the satellite to the launch site for the scheduled 1992 launch.

Information Systems.—The bill authorizes $36,800,000 for Information Systems in FY 1990. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Information systems, total	$36,800,000

The Information Systems program is divided into four major discipline areas: scientific computing; science data management and archiving; science networking; and information systems research and analysis. In addition, the important function of conveying facts about NASA's information and data management systems is undertaken as a part of program management responsibility. The Information Systems program provides the advanced data systems to support the Nation's space sciences and applications flight and research projects.

Scientific computing provides for the operation of super-computing resources of the NASA Space and Earth Sciences Computing Center (NSESCC) in support of modeling and simulation efforts. Also included here are the definition and development of capabilities necessary for efficient use of the Office of Space Science and Applications (OSSA) research and computing assets.

Science data management and archiving provides the OSSA research community with reliable systems to archive and distribute data. The National Space Science Data Center (NSSDC) archives and distributes data acquired from spaceflight investigations. OSSA researchers benefit from automated retrieval of archived data on advanced media as requested by users. Services now under development include catalog inter-operability for common searches across distributed databases and utilization of data exchange standards to facilitate automated assimilation of data by user applications.

The main area of science networking is the NASA Science Internet, a computer networking services developed for NASA's space science and applications community to enable NASA researchers worldwide to connect to databases, computational resources, and other scientists for interactive collaboration. A main objective is to provide transparent and reliable networking connectivity to support OSSA's flight missions and discipline programs, including joint projects with other agencies and international organizations.

Information systems research and analysis emphasize the application of advanced computer and information systems technology to improve the effectiveness and efficiency of science data management, analysis, and visualization.

Information Systems—Committee Comments

In managing its Information Systems programs, NASA must focus increased attention on the issues of data management, data distribution, data archiving, and networking. As mentioned earlier, GAO concluded in a March 1990 report that data management has been a very low priority at NASA, leaving valuable data on global climate change, planetary science, solar physics, and other fields underutilized. As the volume of data from Space Station Freedom and EOS increases, NASA must have an efficient and effective system in place to manage, utilize, distribute, and store this valuable data. The Committee intends to monitor carefully NASA's progress in this area during FY 1991.

Commercial Programs.—The bill authorizes $101,000,000 for Commercial Programs in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Technology utilization	$24,400,000
Commercial use of space	76,600,000
Total	101,000,000

The Technology Utilization program promotes the transfer of technology developed in NASA's R&D programs to the public and private sectors of the U.S. economy. A network of Industrial Applications Centers, Technology Counselors, and NASA Installation Technology Utilization Officers form the core of NASA's technology transfer efforts. Technologies developed for the Nation's aerospace program are reused or reengineered to provide new products and processes in the areas of transportation, energy, medicine, public safety, and consumer goods. The goals of the program are to broaden and accelerate the technology transfer process, to realize additional dividends on the national investment in aerospace re-

search and to ensure that the United States maintains its competitive position in the international marketplace.

The goal of the Commercial Use of Space program is to support a national focus which develops opportunities for the expansion of U.S. private sector investment and involvement in civil space activities. The specific objectives of the program are: (1) to foster close working relations with the private sector and academia to encourage investment in space technology and the use of the *in situ* attributes of space—vacuum, microgravity, temperature, and radiation for commercial purposes; (2) to facilitate private sector space activities through improved access to available NASA resources and the development of new high technology space ventures and markets; (3) to encourage increased private sector investment in the commercial use of space independent of NASA funding; and (4) to implement and support commercial space policy throughout NASA.

NASA's goal of expanding opportunities for U.S. private sector investment and involvement in civil space and space-related activities is pursued through a variety of interrelated programs. Through cooperative agreements such as Joint Endeavor Agreements (JEAs) and through support to the Centers for the Commercial Development of Space (CCDSs), the amount of space-related research conducted by the private sector, the number and type of NASA and private sector facilities available for space use, and the private sector awareness of the opportunity to use NASA's terrestrial and space-based facilities for commercial research will be increased.

Commercial Programs—Committee Comments

This authorization reflects the Committee's strong support for NASA's Commercial Use of Space and Technology Utilization programs.

The Committee supports NASA's strategy of leveraging government and industry funds in its commercial space program. The cornerstone for NASA's activities in this regard are the 16 CCDSs. In the CCDS program, industry is currently contributing approximately $2.2 for every $1 that the Federal Government contributes. Thus, any reduction in Federal funding represents a much larger potential loss in industry investment in space activities.

NASA's commercial programs have traditionally suffered from a lack of firm flight opportunities. However, NASA's proposed flight program for FY 1991 will utilize the middeck of cargo bay of the Space Shuttle, as well as increased use of expendable launch vehicles and commercial middeck augmentation. Every effort must be made to increase flight opportunities for both basic and applied research and commercial applications.

Aeronautical Research and Technology.—The bill authorizes $512,000,000 for Aeronautical Research and Technology in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Research and technology base	$353,400,000
Systems technology programs	158,600,000
Total	512,000,000

The goal of the NASA aeronautics program is to conduct research and develop technology to strengthen U.S. leadership in civil and military aviation. This goal is supported by five comprehensive program objectives: (1) emphasize emerging technologies with potential for major advances in capacity and performance; (2) maintain NASA's laboratory strength by repairing and modernizing critical aging national facilities, providing advanced scientific computational capabilities, and enhancing staff technical excellence; (3) ensure timely transfer of research results to the U.S. aeronautics community through reports, conferences, workshops, and cooperative research programs with industry; (4) ensure strong university involvement to broaden the Nation's base of technical expertise and innovation; and (5) provide technical expertise and facility support to DOD, other government agencies, and U.S. industry for major aeronautical programs. The program is based on a strong commitment to revitalize American competitiveness in the world aviation marketplace, enhance the safety and capacity of the national airspace system, and assure U.S. aeronautical superiority for national security.

In order to continue to meet the international challenge in aeronautics, the aeronautical research and technology program needs to address critical barriers and strengthen generic technology development in selected high payoff areas that are vital to our long-term leadership in aviation. NASA's FY 1991 aeronautics program is focused on achieving the long-term objectives established in the report, "National Aeronautical R&D Goals: Technology for America's Future," by the Office of Science and Technology Policy (OSTP), and in its sequel report, "Agenda for Achievement."

There are many important elements of the research and technology base and systems technology programs. Fluid and thermal physics research emphasis will be placed on analytical, computational, and experimental studies of turbulence and transition physics with emphasis on the supersonic flow regime. In applied aerodynamics, the research program in FY 1991 will include efforts in subsonic/transonic drag reduction and additional activities in configuration aerodynamics which focus on new, nonconventional platforms having improved maneuverability and performance for both subsonic and supersonic flight. Propulsion and power research will continue to emphasize improved understanding of the governing physical phenomena at the disciplinary, component, and subsystem level leading to future high-payoff improvements in capability and efficiency. Materials and structures research will continue to focus on developing advanced materials and innovative structural concepts aimed toward reducing aircraft weight and cost. Research in information sciences will continue to be focused on concurrent processing for ultra high-reliability and high-performance architectures which will be more immune to hardware and software failures. Controls and guidance research will continue working toward providing a technology base which supports aircraft designs capable of safer and more efficient operation and having greatly expanded flight envelopes. Human factors research will continue to

focus on flight management, human engineering methods, and cockpit automation aids. Flight systems research will be directed toward the aeronautical technology needs of aviation safety, flight test methodologies, and current and future high-performance aircraft. Systems analysis studies will continue to focus on defining the research and technology needs for civil and military aircraft and on developing advanced analytical techniques and modeling capabilities to conduct credible sensitivity studies and tradeoff analyses.

In materials and structures systems technology, the advanced high-temperature engine materials program will focus on the development of metal-matrix and ceramic-matrix composites. In rotorcraft systems technology, noise vibration prediction methods will be validated from tiltrotors, and innovative noise control concepts will be explored. In high performance aircraft systems technology, research will continue to concentrate on the application of flight/propulsion controls integration for enhanced mission effectiveness. In advanced propulsion systems technology, several advanced technology concepts for future aircraft propulsion will continue to be explored and exploited, including advancements in commercial aviation turboprop and general aviation small gas-turbine engines. In numerical aerodynamic simulation capability, the third high-speed processor will be enhanced in the areas of advanced graphics, sophisticated work stations, Unix-based mass storage system, and upgraded communication for local and remote users. The high-speed research program will build on efforts initiated in FY 1990 to resolve critical environmental issues, including effects on ozone depletion, airport noise, and sonic boom, in a manner that will allow the United States to make informed decisions on high-speed civil transport technology development.

Aeronautical Research and Technology—Committee Comments

The Committee continues to strongly support the NASA aeronautical research and technology program and sees it as a critical element of the success of the U.S. aerospace industry in the world marketplace. Aerospace is now this country's leading trade surplus industry. Much of this success lies with NASA's work on emerging technologies that are essential in retaining and enhancing that leadership position. Accordingly, the Committee has authorized the full budget request for FY 1991.

Recognizing the significant potential for any new high-speed commercial aircraft, NASA is to be commended for highlighting research on high-speed aircraft in the FY 1991 budget request. Even apart from the enormous economic issues that remain to be resolved, there are several very significant environmental concerns, including ozone depletion, sonic boom, and airport noise, that threaten to limit future development of high-speed civil transport aircraft. Accordingly, the Committee fully supports NASA's efforts to better understand these environmental issues as they relate to the high-speed commercial transport.

The bill also authorizes enhanced funding for research on advanced composites in the FY 1991 budget. In conducting this research, NASA should provide a balanced share for advanced metal-

lic aeronautical materials technology development and productivity enhancements. Otherwise by funding composite technology and not metallics technology, NASA would be promoting one material over others that may lead to new aeronautical materials.

Transatmospheric Research and Technology.—The bill authorizes $119,000,000 for Transatmospheric Research and Technology in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Transatmospheric research and technology, total	$119,000,000

The Transatmospheric Research and Technology program represents NASA's portion of the joint NASA/DOD National Aerospace Plane (NASP) program. The program objective is to develop and then demonstrate, in an experimental flight vehicle, the technology required to permit the Nation to develop reusable, single-stage-to-orbit vehicles with airbreathing primary propulsion capable of achieving hypersonic velocities (up to Mach 25) using horizontal takeoff and landing on conventional runways.

The NASP program was revised and rescheduled in the summer of 1989, based on the President's endorsement of the National Space Council's recommendations to extend the second, current phase of the program, which focuses on technology development. Important work remains on propulsion, materials and structures, controls, and applications of computational fluid dynamics. Emphasis is also placed on integrating these technologies into vehicle concepts to assess both vehicle and technology potential. A decision in the second quarter of FY 1993 will determine whether to proceed to Phase 3, which consists of designing, constructing, and flight testing an experimental flight vehicle, the X-30.

Transatmospheric Research and Technology—Committee Comments

While the focus of the NASP program has been restricted to the development of the supporting technologies and the subsequent design and construction of an experimental vehicle with which to test those technologies, the potential NASP spinoffs may be significant. For example, NASP may eventually emerge as viable competitor to other launch systems for placing either civil or military payloads in space. NASP may well produce significant breakthroughs for the United States in aeronautics; it has the potential to be the next great advance in transportation and could enhance significantly the ability of the United States to compete in future global markets. Accordingly, the Committee has authorized the full $119,000,000 requested by the President in FY 1991 for NASP.

In May 1990, the NASP contractors received approval from the Federal government for a teaming concept that will enable both the airframe and propulsion contractors to work in a concerted fashion to pursue a single design concept. This teaming concept should allow more efficient use of the NASP contractors' skills and resources and thereby will help ensure the successful completion of the Phase II technology development phase of the project.

Space Research and Technology.—The bill authorizes $407,900,000 for Space Research and Technology in FY 1991. This is $88,000,000 less than the President's budget request.

Summary of fiscal year 1991 funding levels

Research and technology base	$125,700,000
Civil space technology initiative (CSTI) program	171,000,000
Pathfinder program	91,400,000
In-space experiments technology program	19,400,000
Total	407,900,000

The overall goal of the space research and technology program is to provide advanced, enabling technologies, validated at a level suitable for user-readiness, for future space missions in order to ensure continued U.S. leadership in space to meet national needs. To achieve this goal, a commitment is required to provide a broad base of advanced technology for vehicle and subsystem concepts, components, devices, and software; to develop technical strengths in the engineering disciplines within NASA, industry, and academia; and to perform critical technology demonstrations that facilitate the transfer of new technology with a high level of confidence to future space missions.

The space research and technology program consists of two basic program areas, the research and technology base program and the focused programs. The objective of the research and technology base program is to gain a fuller knowledge and understanding of the fundamental aspects of phenomena in critical disciplines. Within the research and technology base program, high-leverage technological advances and concepts are brought to the level of demonstrating proof of principle. The base program is the seedbed for generating the more highly mission-focused technology programs.

Focused programs, based on requirements provided by the potential users of the technology, develop technology for future specific applications and deliver products in the form of proven hardware, software, and design techniques and data. Three focused programs are currently underway, the Civil Space Technology Initiative (CSTI), the Exploration Technology program, which encompasses the previous Pathfinder program, and the In-Space Technology Experiments Program. The CSTI program is a positive first step to strengthen NASA's technical base and provide options for future low Earth orbit high priority civil space goals. CSTI is developing technologies to enable efficient, reliable access to Earth orbit; enhance operations in low Earth orbit; and increase the effectiveness of science missions from low Earth orbit. The Exploration Technology program is developing critical capabilities to enable potential future missions, both human and robotic, to expand human presence and activities beyond Earth's orbit into the solar system. It will push U.S. technology forward through a strong partnership between NASA, industry, and universities. Proof-of-concept testing for mission-critical engineering designs will be an important product of the CSTI and Exploration Technology programs and will support directly the continuing evolution and maturation of mission plans. The In-Space Technology Experiments program will develop key flight experiments to provide valuable information for solving critical technology problems.

Space Research and Technology—Committee Comments

This authorization figure reflects the Committee's decision to terminate the full $88,000,000 requested under this portion of the budget to support the proposed Space Exploration Initiative. Without funding the proposed Moon/Mars mission, the bill still provides $123,800,000 more in FY 1991 than has been made available in the NASA FY 1990 Operating Plan for Space Research and Technology programs.

The proposed Space Exploration Initative, which calls for human exploration of the Moon and Mars is consistent with the long-range goal of the National Space Policy of expanding human presence and activity beyond Earth orbit and into the solar system. Much like the Apollo missions of an earlier era, such a mission may well lead to technological breakthroughs and commercial spinoffs of significant benefit.

Notwithstanding potential future benefits, however, the Committee is concerned that in the current fiscal environment, the Federal government may not have the resources needed to initiate the ambitious program proposed in the President's Space Exploration Initiative. Human exploration of the Moon and Mars would be very costly, both in the near-term and long-term. According to NASA's budget submission, total funding needs for the Moon/Mars mission are expected to grow to $444,000,000 in FY 1992 and $649,000,000 in FY 1993. When testifying before the Committee earlier this year, NASA could not specify the annual budget requirements of such a mission beyond that point, but estimates of its total cost range upwards of $500 billion over the next several decades.

In current fiscal environment, growth in NASA's budget necessary to support the Space Shuttle program, development and launch of the Space Station Freedom, initiation of EOS and other components of the Mission to Planet Earth, as well as the Space Exploration Initiative, would be difficult. The priority in FY 1991 therefore must be to ensure adequate funding of NASA's on-going programs. Ninety-eight percent of the FY 1991 NASA budget has been requested to continue these on-going programs. Additional significant funding requirements imposed by the Space Exploration Initiative could limit the availability of resources for these other high priority space programs.

In addition, the current Space Exploration Initiative has not been adequately defined to begin committing hundreds of millions of taxpayer dollars to it. Funds have been requested in FY 1991 for certain specific technology development programs, including vehicle technologies, space transportation, and in-space and surface operations. Yet, there is no clear idea of how the proposed mission to the Moon and Mars would be structured, the total cost of either aspect of the mission, its scientific objectives, or the level of international participation.

It is therefore prudent to await a better definition of these difficult issues before committing scarce taxpayer resources to the Space Exploration Initiative. To help in this mission definition, the reported bill provides NASA with its full budget request for Exploration mission studies, which is outlined in the next section.

Apart from the Space Exploration Initiative, the reported bill fully funds the Space Research and Technology base programs at the requested level, realizing their importance to the future of other aspects of the U.S. space program.

Exploration Mission Studies.—The bill authorizes $37,000,000 for Exploration Mission Studies in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Exploration mission studies, total	$37,000,000

In FY 1991, a series of mission studies, technology trades and analyses of science opportunities will be initiated. This series encompasses mission integration studies in transportation systems, surface systems development, and the use of *in-situ* resources, power, and propulsion systems life-support requirements and robotics; a mission analysis program; and mission concept studies. These studies will provide mission design options and the effects of alternative scenarios, prerequisite mission requirements and tehcnology requirements on NASA infrastructure and systems for future exploration of the solar system.

Exploration Mission Studies—Committee Comments

The bill authorizes the full budget request for Exploration mission studies in FY 1991 in recognition of the need for NASA to better develop the structural framework of future missions, both manned and unmanned.

By requesting these funds in FY 1991, the Administration's intent was to initiate a number of studies that would focus solely on the President's proposed mission to the Moon and Mars. The Committee deleted funds in this bill for the Space Exploration Initiative to ensure that NASA would focus its attention on its numerous on-going, near-term missions. However, since the Exploration Mission studies proposed by NASA could assist in enhanced definition of other missions under NASA's direction, this program is funded at the requested level in FY 1991.

The bill also specifies that the funds authorized for Exploration Mission studies are to used only on studies that are to be conducted solely by NASA. Accordingly, none of the funds authorized are to be used by NASA to issue contracts under this program to aerospace contractors.

Safety, Reliability, Maintainability and Quality Assurance.—The bill authorizes $33,000,000 for Safety, Reliability, Maintainability, and Quality Assurance (SRM&QA). This is the same as the President's budget request and manifests the Committee's support for this critical element of NASA.

Summary of fiscal year 1991 funding levels

Safety, reliability, maintainability and quality assurance (SRM&QA)	$28,000,000
Applied technologies	5,000,000
Total	33,000,000

The SRM&QA program actively supports NASA agency-wide goals. This support is achieved by the implementation of proce-

dures that reduce program risk—procedures relating to safety, reliability, quality assurance, maintainability, systems assessment, and program assurance, including independent assessment and trend analysis activities.

Specific program objectives are: (1) develop and implement top-level NASA safety policies, and define program specific safety requirements; (2) develop an independent mission safety evaluation for each mission and an independent capability to perform technical assessments to support the SRM&QA decision process; (3) provide technical guidance and support to NASA programs, including Shuttle readiness reviews and launch operations; (4) support a risk management program that provides management visibility into problems and technical risks and analyses and corrective actions; (5) develop a human factors engineering program and promulgate safety tools and techniques; (6) conduct independent quantitative risk assessments and perform hazard analyses; (7) provide functional management in reliability, maintainability, and quality assurance for software assurance, electronic, and mechanical parts and assemblies, and standards assurance; (8) develop and evaluate cost-effective quality program; (9) assure development and maintenance of systems of communicate problems and provide tools which analyze trends and predict and prevent serious problems; (10) review and evaluate NASA and contractor SRM&QA activities to verify conformance with established policies and procedures; (11) continue to improve the automation of the SRM&QA Management Information Centers, while developing procedures and systems to manage effectively SRM&QA data; and (12) foster a total quality management philosophy throughout NASA and its contractors and suppliers.

Safety, Reliability, Maintainability and Quality Assurance—Committee Comments

The recent discovery of an optical flaw in the Hubble Space Telescope that went undetected until after its launch highlights the importance of a strong, effective, and independent SRM&QA program within NASA. While there may have been lapses in NASA's quality control effort in the past, improvements made in this area since the 1986 Challenger accident have helped to restore public confidence in NASA. An indication of the commitment to SRM&QA by the current NASA management team is the fact that NASA's total civil service work force dedicated to SRM&QA has increased from 845 in 1986 to approximately 1,330 today. The Committee strongly supports the enhanced SRM&QA program at NASA and has provided the full budget request for FY 1991.

NASA has proposed a new applied technology activity to resolve issues in engineering, manufacturing, and quality control in the FY 1991 budget, which the Committee has fully funded in the reported bill. Special emphasis in this program will be placed on defining reasonable hardware quality requirements and improved technical standards by focusing on design, engineering, and process control. That is, work will be directed toward understanding the technical elements of design that assure acceptable performance and, in particular, process control. This effort will greatly enhance

safety, reliability, and maintenance assurance in areas critical to NASA missions, including the Space Station Freedom.

Academic Programs.—The bill authorizes $50,100,000 for the University Space Science and Technology Academic Programs in FY 1991. This is the same as the President's budget request and reflects the Committee's strong support of these programs.

Summary of fiscal year 1991 funding levels

Educational affairs	$23,200,000
Minority university research	16,800,000
Space grant college and fellowship	10,000,000
Total	50,100,000

The Educational Affairs program, together with the Minority University Research program and the Space Grant College and Fellowship program, became a new budget line item in the FY 1990 budget.

The goal of the NASA University Affairs program is to create and maintain strong and mutually productive working relationships with the Nation's university community. To accomplish this goal, the Office of External Relations and the Office of Space Science and Applications manage certain unique university programs that are agency-wide in scope and interest but are not within the direct responsibility of NASA program offices.

The specific objectives of the Educational Affairs program are: (1) to increase significantly the number of highly trained scientists and engineers in aeronautics, space science, space applications and space technology to meet the continuing needs of the national aerospace effort; (2) to facilitate the direct interaction, further the professional knowledge, and stimulate the exchange of ideas among university faculty members and NASA scientists and engineers; (3) to support innovative research at U.S. institutions of higher learning, research which is in the formulative or embryonic stage and which would appear to have significant potential to advance space science and applications programs; (4) to provide for the development and use of a core, long-term U.S. national university capability to conduct multiyear, Earth science discipline-oriented applied research and remote sensing; (5) to encourage elementary level students to take greater interest in mathematics, science, and technology through the use of advanced instructional technology, development of strong teacher resource centers, and curriculum materials designed for the elementary level, and to initiate cooperative relationships with private industry, local school systems, and community organizations; (6) to involve the educational community, both students and teachers, in better understanding the knowledge derived from NASA research and development through information dissemination, teacher workshops, and aerospace oriented learning activities; and (7) to stimulate interest in science and technology through direct involvement of secondary school students in space research by providing opportunities to propose experiments for possible testing in NASA facilities.

Academic Programs—Committee Comments

Probably the most valuable contribution of the U.S. space program is the strong stimulus it provides to young students' interest in science, engineering, and mathematics. The reported bill supports specific NASA efforts aimed at using space endeavors in classrooms around the country to help in assuring American preeminence in math and science education. The Educational affairs programs, minority university research, and Space Grant College and Fellowship Program help provide the means by which this stimulated interest is focused in scientific and technical academic education. The Committee endorses these programs, believing they are sound investment in the future of not only the space program but also America's youth. Accordingly, the reported bill provides the full amount requested in FY 1991 to support NASA's academic programs.

Tracking and Data Advanced Systems.—The Committee authorizes $20,000,000 for Tracking and Data Advanced Systems in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Advanced systems, total	$20,000,000

The Advanced Systems program is designed to study and develop new higher performance tracking and data handling capabilities which will address planned future mission requirements and will provide improved cost-effectiveness and reliability for overall support of the total mission mix.

This activity is vital to the future of Space Operations programs. Advanced Systems programs focus on assessing and employing technological advances in telecommunications, electronic microcircuitry, and computer sciences. Such an effort is essential for the cost-effective application of new technology and for the planning of future mission support capabilities. Ongoing work includes the investigation of the total data transfer and processing needs of upcoming missions and studies of ground systems and telecommunication links to determine design approaches and overall tradeoffs for the lowest life cycle costs to support future space missions.

Tracking and Data Advanced Systems—Committee Comments

The Committee strongly supports the Tracking and Data Advanced Systems Programs and thus has provided the full budget request for FY 1991. This program will provide for higher performance tracking and data handling capabilities, which will be needed with the Space Station Freedom and EOS. Efforts to address these requirements and to develop the required technologies to assist in the effective utilization of this data are critical to the success of these programs and should be a high NASA priority.

Space Flight, Control, and Data Communications

Section 101(b) authorizes appropriations to NASA to become available October 1, 1990 for "Space flight, control, and data communications". This subsection authorizes a total of $5,189,400,000 for FY 1991 activities, including funds for space shuttle production and operational capability ($1,302,000,000), space transportation op-

erations ($3,118,600,000), and space and ground network, communications and data systems ($868,800,000). In addition, the bill includes a one-time authorization for the TDRSS ($1,209,732,000), which shall be used only for the purpose of reducing all outstanding debt to the Federal Financing Bank.

The reported bill reflects the Committee's continuing strong support for a safe and reliable space transportation system, by providing a total of $5,189,400,000 in FY 1991 for the sustained development and operation of the Space Shuttle program, continued use of expendable launch vehicles, and tracking, telemetry, command, and data acquisition support for all NASA flight projects using ground-based and satellite components. The amount provided reflects a general reduction of $100,000,000 from the President's request for FY 1991, which is to be applied at NASA's discretion, provided such reductions do not affect adversely the sustained operation of a safe and reliable Space Shuttle system. Nonetheless, the reported bill is $637,400,000 more than the FY 1990 NASA Operating Plan.

The bill also includes $1,209,732,000 to reduce all outstanding debt to the Federal Financing Bank for the construction of the TDRSS. This is a one-time non-expenditure transfer and does not represent new money.

Space Shuttle Production and Operational Capability.—The bill authorizes $1,302,000,000 for Space Shuttle Productions and Operational Capability in FY 1991. This is the same as the President's budget request and reflects a strong desire to maintain the safety and reliability of the Nation's space transportation system.

Summary of fiscal year 1991 funding levels

Orbiter operational capability	$213,600,000
Propulsion systems	822,900,000
Launch and mission support	265,500,000
Total	[1] 1,302,000,000

[1] This amount could be further reduced if NASA decides to apply any part of the $100,000,000 general reduction to the Space Flight, Control and Data Communications account to this line item.

The objectives of this program are to provide for the reusable hardware inventory and necessary design modifications and improvements to support the Space Transportation System (STS) flight requirements; the development and production of an Advanced Solid Rocket Motor (ASRM) and other propulsion systems; development of launch site and flight operations capabilities; and an Extended Duration Orbiter (EDO) capability.

With the loss of the Challenger in January 1986, the orbiter fleet was reduced to three vehicles. The current orbiter fleet includes Columbia, the orbiter developed and flown on four test and evaluation flights, and two orbiters of a lighter weight configuration, Discovery and Atlantis. A fourth orbiter, Endeavor, is now being manufactured and is planned to be delivered in FY 1991. The budget provides funding for necessary improvements, hardward fixes, and mission kits for the orbiter fleet to satisfy flight requirements. In addition, the Kennedy Space Center is continuing the procurement of an orbiter spares inventory needed to support the flight rate buildup. The EDO development is also included to increase on-orbit

stay time in order to improve the shuttle capability to support payload requirements.

Launch and Mission Support provides for Launch Operations and Flight Operations capability to meet STS program objectives. At the Kennedy Space Center, there is a second line of facilities allowing simultaneous processing and checkout of orbiters and associated flight hardware from landing through launch. At the Johnson Space Center, mission support provides collateral hardware, principally the extra-vehicular maneuvering units, while mission operations capability provides for improvements in the flight support systems. The flight support systems funded by this budget include training and carrier aircraft, additional landing aids and runway end barriers at the primary and contingency landing sites, and replacement/upgrade of equipment in the mission support complex, including the Shuttle mission simulator and the mission control center.

Propulsion systems provide for the continued development and extensive testing of the Space Shuttle Main Engines (SSME), the development of the capability to support operational requirements established for the Solid Rocket Boosters (SRBs) and external tanks (ETs), and the development of an ASRM.

The SSME program includes: production of main engines necessary for the orbiter fleet and a spares inventory, ground testing in support of engine development, anomaly resolution, product improvement, and advanced development efforts to improve operating margins.

SRB production and capability development activities include: static test firing of STS-51 configuration solid rocket motors for reclamation of reusable hardware and engineering evaluation data; evaluation of returned flight hardware; procurement of manufacturing process control tooling and equipment to support flight rate; and selected studies to continue investigative, analytical, and problem-solving activities.

Development of the ASRM is targeted for initial flight deliveries beginning in early 1996. The program will include the design, development, test, evaluation, and integration of the ASRM and the design and construction of production equipment for a new government-owned, contractor-operated production and test facility.

Space Shuttle Production and Operational Capability—Committee Comments

There have been 10 successful flights of the Space Shuttle since the tragic Challenger disaster in 1986. The return to flight of a safe, reliable Space Shuttle has been a long and arduous process and has been the result of the hard work and dedication of the NASA/contractor team. The challenge in FY 1991 and in future years is to maintain Space Shuttle safety and reliability, while continuing to upgrade and increase the margin of safety and reliability of the Shuttle's systems and components.

The Committee is pleased that work has begun on the development of the ASRM. The ASRM is critical to the safety and reliability in both the SRBs and the total Space Shuttle system. The 12,000 pounds of increased performance that the ASRM is expected

to provide will improve the Space Shuttle's margin of safety while enhancing greatly its ability to carry payloads to low Earth orbit. NASA is urged to expend every reasonable effort to keep the ASRM program on schedule and within design specifications.

The Committee has fully funded the structural spares program in recognition of the need to pursue their timely acquisition. Doing so would assure the availability of replacements for major components in the event of an accident or incident involving an orbiter on the existing fleet. Secondly, it will facilitate the continuance of vital technical expertise. Finally, a stock of structural spares would streamline the acquisition of another Space Shuttle orbiter, should Congress authorize it in the future.

Space Transportation Operations.—The bill authorizes $3,118,600,000 for Space Transportation Operations in FY 1991. This is the same as the President's budget request and reflects the Committee's strong desire to maintain the safety and reliability of the Nation's space transportation system.

Summary of fiscal year 1991 funding levels

Flight operations	$815,600,000
Flight hardware	1,467,200,000
Launch and landing operations	606,600,000
Shuttle operations	2,889,400,000
Expendable launch vehicles (ELVs)	229,200,000
Total	[1] 3,118,600,000

[1] The amount could be further reduced if NASA decides to apply any part ofthe $100,000,000 general reduction to the Space Flight Control and Data Communications account to this line item.

Space Transportation Operations provides launch services to NASA payloads using a mixed fleet approach of both the Shuttle and Expendable Launch Vehicles (ELVs). Launch services also are provided, on a reimbursable basis, to DOD, other civil agencies, and certain commercial and international users.

The Flight Operations activity is divided into three major elements; mission support, integration, and support. Mission support includes training, flight operations activities, and a wide variety of planning activities ranging from operational concepts and techniques to detailed systems operational procedures and checklists. Integration includes production of flight software, launch support services and sustaining engineering for orbiter systems, cargo analytical integration, and systems integration. The support element includes systems support activity at the Johnson Space Center, such as aircraft operations, engineering support, and support to the Space Shuttle program office. Shuttle system support for program and integration activities at Headquarters, the Marshall Space Flight Center, and the Stennis Space Center is also included.

The Flight Hardware program element provides for: the procurement of ETs and SRB elements including motors, booster hardware, and propellants; replenishment of spare parts inventory and repair of the SSME; orbiter and crew equipment; ET disconnects; logistics support for the orbiter ET, SRB, SSME flight hardware elements; and maintenance and operations of flight crew equipment. Included in the funding request for tanks and boosters are the long lead time raw materials, subassemblies, subsystems, and

additional ground testing of the redesigned solid rocket motor (SRM) necessary to sustain and verify the production of elements in a manner consistent with the flight rate requirements.

Launch and Landing Operations provides for the prelaunch preparation, liquid propellants, launch, and landing operations of the Shuttle and its cargo.

The ELVs/Mixed Fleet plan was initiated after the Challenger accident as a result of an assessment of NASA's space transportation requirements. This assessment showed that several U.S. civil government spacecraft should be launched on ELVs in order to provide increased access to space, to assure continuity of space operations, and to enhance mission flexibility. The missions currently planned for launch on ELVs are spacecraft requiring West Coast launches and selected East Coast launches which do not require the Shuttle's unique capabilities.

Space Transportation Operations—Committee Comments

The Committee looks forward to the return to flight of the Space Shuttle fleet following discovery of hydrogen leaks in the umbilical assemblies of the Space Shuttles Columbia and Atlantis, as well as a return to the planned manifest which calls for an increasing flight rate which would reach twelve Shuttle flights a year later this decade. However, without question, the operation of a safe, reliable transportation system must be NASA's top priority. In this regard, as in previous years, the Committee endorses safety/reliability over flight rate. The recent grounding of the Space Shuttle fleet in the aftermath of NASA's discovery of the hydrogen fuel leaks serves as an example of NASA's commitment to this philosophy, which the Committee strongly supports.

Space Tracking and Data Acquisition.—The bill authorizes $868,800,000 for Space Tracking and Data Acquisition in FY 1991. This is the same as the President's budget request.

Summary of fiscal year 1991 funding levels

Space network	$331,200,000
Ground networks	267,800,000
Communications and data systems	269,800,000
Total	[1] 868,800,000

[1] This total could be further reduced if NASA decides to apply any part of the $100,000,000 general reduction to the Space Flight, Control and Data Communications account to this line item.

The purpose of this Space Tracking and Data Acquisition program is to provide vital tracking, telemetry, command, data acquisition, communications, and data processing support to meet the requirements of all NASA flight projects. In addition to NASA flight projects, support is provided on a reimbursable basis for DOD projects, other government agencies, commercial firms, and other countries and international organizations. Support is provided for Earth orbital, planetary, and solar system exploration spacecraft missions, launch vehicles, research aircraft, sounding rockets, and balloons.

Tracking and acquisition of data for the space projects is presently accomplished through the use of a worldwide network of NASA ground stations and by two tracking and data relay satellites in

geosynchronous orbit working with a highly specialized ground station. Ground facilities are interconnected by terrestrial and satellite communications circuits linking the spacecraft and their control centers for execution of the missions.

NASA has three basic support capabilities to meet the needs of all classes of NASA flight missions. These are the Spaceflight Tracking and Data Network, which currently supports Earth orbital missions; the Deep Space Network, which primarily supports planetary and interplanetary flight missions; and the Space Network, including the TDRSS, which provides most low Earth orbital mission support.

Highly specialized computation facilities provide real-time information for mission control and accommodate processing into meaningful form the large amounts of scientific, applications, and engineering data which are collected from flight projects. In addition, instrumentation facilities provide support for sounding rocket and balloon launchings and flight testing of aeronautical research aircraft.

Space Tracking and Data Acquisition—Committee Comments

The Committee supports NASA's baseline program for the TDRSS, including development of the TDRS-8 spacecraft. TDRS-8, which is scheduled to be launched in September 1995, is the last of the current spacecraft design. TDRS-8 is critical to the requirements of the TDRSS.

Construction of Facilities

Section 101(c) authorizes appropriations to NASA to become available October 1, 1990 for "Construction of facilities", including land acquisitions. This subsection authorizes a total of $497,900,000 for a variety of repair, rehabilitation, and new construction activities required to support the civilian space program. This amount is the same as the President's request for FY 1991, which is a $86,900,000 increase over the FY 1990 NASA Operating Plan.

Summary of fiscal year 1990 funding levels

(1) Construction of Neutral Buoyancy Laboratory, Johnson Space Center	$15,000,000
(2) Construction of Space Station Processing Facility, Kennedy Space Center	25,000,000
(3) Construction of Addition for Flight Training and Operations, Johnson Space Center	12,000,000
(4) Rehabilitation of Mission Control Center Power and Control Systems, Johnson Space Center	8,500,000
(5) Construction of Transporter/Canister Facility, Kennedy Space Center	5,500,000
(6) Construction of Processing Control Center, Kennedy Space Center	9,400,000
(7) Replacement of Heating, Ventilating, and Air-Conditioning System, Hypergolic Maintenance Facility, Kennedy Space Center	2,100,000
(8) Replacement of Operations and Checkout Building, West Cooling Tower, Kennedy Space Center	1,000,000
(9) Restoration of Heavy Equipment Area, Kennedy Space Center	900,000
(10) Upgrade of Orbiter Processing Facility High Bay Heating, Ventilating, and Air-Conditioning System, Kennedy Space Center	3,300,000
(11) Upgrade of Yundum International Airport to Full Transoceanic Abort Landing Site, Benjul, The Gambia	3,400,000

(12) Repair of Condensate System, Main Manufacturing Building, Michoud Assembly Facility	900,000
(13) Construction of Project Engineering Facility, Marshall Space Flight Center	17,000,000
(14) Restoration of Information and Electronic Systems Laboratory, Marshall Space Flight Center	4,000,000
(15) Rehabilitation of Hydrogen Transfer Facility, Stennis Space Center	2,700,000
(16) Restoration of Space Shuttle Main Engine Test Complex A, Stennis Space Center	2,800,000
(17) Construction of Advanced Solid Rocket Motor Program Facilities, various locations,	92,000,000
(18) Construction of Addition to Site Electrical Substation, Johnson Space Center	11,000,000
(19) Addition to Administration and Engineering Building, Stennis Space Center	3,800,000
(20) Construction of Earth Observing System Data Information System Facility, Goddard Space Flight Center	8,000,000
(21) Construction of Detector Development Laboratory, Goddard Space Flight Center	3,100,000
(22) Replacement of Chillers, Central Heating/Refrigeration Plant, Goddard Space Flight Center	4,000,000
(23) Replacement/Modernization of Electrical Power Feeders, Goddard Space Flight Center	1,500,000
(24) Construction of Observational Instruments Laboratory, Jet Propulsion Laboratory	14,000,000
(25) Refurbishment of 25-Foot Space Simulator, Jet Propulsion Laboratory	13,200,000
(26) Restoration of Utilities, Wallops Flight Facility	5,200,000
(27) Modifications to the High Pressure Air System, Langley Research Center	12,000,000
(28) Modifications to Upgrade the 30 x 60-Foot Wind Tunnel, Langley Research Center	4,000,000
(29) Repairs to the Tunnel Shell, Unitary Plan Wind Tunnel, Langley Research Center	2,700,000
(30) Rehabilitation of Central Air System, Lewis Research Center	7,900,000
(31) Rehabilitation of Propulsion Systems Laboratory, Lewis Research Center	6,000,000
(32) Construction of Liquid Hydrogen Structural Test Facility, Dryden Flight Research Facility	18,800,000
(33) Rehabilitation and Modification of the Electrical Distribution System, Dryden Flight Research Facility	4,000,000
(34) Construction of Addition for Light-Alloy Research Laboratory, Langley Research Center	4,600,000
(35) Construction of Space Experiments Laboratory, Lewis Research Center	7,100,000
(36) Refurbishment of Electric Power Laboratory, Lewis Research Center	8,900,000
(37) Construction of 34-Meter Multifrequency Antenna, Goldstone, California, Jet Propulsion Laboratory	13,200,000
(38) Rehabilitation of 70-Meter Antenna Drive Gear Boxes in Australia, Spain, and Goldstone, California, Jet Propulsion Laboratory	4,400,000
(39) Repair of facilities at various locations, not in excess of $1,000,000 per project	30,000,000
(40) Rehabilitation and modification of facilities at various locations, not in excess of $1,000,000 per project	34,000,000
(41) Minor construction of new facilities and additions to existing facilities at various locations, not in excess of $750,000 per project	11,000,000
(42) Environmental compliance and restoration	32,000,000
(43) Facility planning and design not otherwise provided for	28,000,000

The CoF authorization provides contractual services for the repair, rehabilitation, and modification of existing facilities; the construction of new facilities and the acquisition of related facility equipment; environmental compliance activities; the design of fa-

cilities projects; and advanced planning related to future facilities needs.

The funds requested for FY 1991 provide for continuing prior year endeavors to meet facilities requirements for the Space Station Freedom and Space Flight Programs; construction of new facilities needed to support science, space technology, and aeronautical research; repair, rehabilitation, and modification of other facilities to maintain, upgrade, and improve the usefulness of the NASA physical plant; minor construction of new facilities, facility planning and design activities; and environmental compliance and restoration.

The projects and amounts in the budget estimates reflect Space Station Freedom and Space Flight facilities requirements that are time-sensitive to meet specific program objectives. Other program requirements for FY 1991 include construction of an addition to the site electrical substation at the Johnson Space Center; construction of an addition to the Administration and Engineering Building at the Stennis Space Center; construction of a Detector Development Laboratory, initial construction for the Earth Observing Systems Data Information Systems Facility, replacement of chillers in the central heating/refrigeration plant, and replacement/modernization of electrical power feeders at the Goddard Space Flight Center; construction of an Observational Instruments Laboratory and refurbishment of the 25-foot Space Simulator at the Jet Propulsion Laboratory; restoration of utilities at the Wallops Flight Facility; projects to repair, restore, and modernize NASA's aeronautical research and development facilities at the Lewis and Langley Research Centers; construction of a Liquid Hydrogen Structural Test Facility and rehabilitation and modification of the electrical distribution system at the Dryden Flight Research Facility; construction of an addition for a Light-Alloy Research Laboratory at the Langley Research Center; construction of a Space Experiments Laboratory and refurbishment of the Electric Power Laboratory at the Lewis Research Center; construction of 34-meter multi-frequency antenna in Goldstone, CA; and rehabilitation of the 70-meter antenna drive gear boxes in Australia, Spain, and Goldstone, CA.

The FY 1991 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe, economical, and efficient use of the NASA physical plant. This bill continues the necessary rehabilitation and modification program begun by NASA in prior years and continues a repair program. The repair program restores facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements. The environmental compliance and restoration program ensures that statutory environmental requirements are met and any necessary remedial action promptly taken.

Construction of Facilities—Committee Comments

In recent years, the importance of the physical plant at the various NASA Centers has been neglected. This authorization reflects the critical role that NASA facilities play in the civil space program. Authorizing the full $497,900,000 requested in the FY 1991 budget should ensure that NASA's physical plant is properly maintained.

Research and Program Management

Section 101(d) authorizes appropriations to NASA to become available October 1, 1990 for "Research and program management". This subsection authorizes a total of $2,252,900,000 for all civil service staff, maintenance of facilities, and support of research and development programs and contract activities, as well as technical and administrative support of research and development programs. The reported bill provides the same level as the President's request for FY 1991, which is a $229,400,000 increase over the FY 1990 NASA Operating Plan.

Summary of fiscal year 1991 funding levels

Personnel and related costs	$1,392,156,000
Travel	54,056,000
Operation of installation	806,688,000
Facilities services	(342,207,000)
Technical services	(197,525,000)
Management and operations	(266,956,000)
Total	2,252,900,000

The Research and Program Management authorization funds the performance and management of research, technology, and test activities at NASA installations, and the planning, management, and support of contractor research and development tasks necessary to meet the Nation's ongoing objectives in aeronautical and space research. The objectives of the activities funded by the Research and Program Management appropriation are: (1) to provide a civil service staff with the technical and management skills to conduct the full range of programs for which NASA is responsible; (2) to provide base maintenance of facilities in support of research and development programs; and (3) to provide effective and efficient technical and administrative support for the research and development programs.

The civil service work force is the underpinning of the successful accomplishment of the Nation's civil aeronautics and space programs. In FY 1991, NASA plans to utilize 24,466 Full-Time Equivalent employees in that work force. These are the people who plan the programs; conduct and oversee the research; select and oversee the contractors; manage the various research, development, and test activities; and oversee all of NASA's operations. The salaries and related costs of the NASA work force comprise over 62 percent of the Research and Program Management authorization. Slightly two percent is required to fund the travel necessary to manage NASA and its program. The remaining amount provides support to the civil service work force and the NASA Centers' physical plant. An obvious example of this support is the electricity to operate

NASA's many wind tunnels. The library at each of the NASA Centers is also funded by this authorization and is a major research tool. The photo lab, print shop, and graphics capability are absolutely necessary to document research results, to publish and present the research, and to print checkout procedures. Security and fire protection are funded under this authorization.

Research and Program Management—Committee Comments

This authorization reflects the Committee's strong support of NASA's personnel.

While the precise cause of the flaw in the Hubble Space Telescope has yet to be identified, testimony before the Committee in recent oversight hearings has highlighted the fact that NASA did not conduct adequate oversight during early phases of the Space Telescope's development. This has highlighted the critical importance of adequate civil service staffing levels to ensure effective oversight of contractor activities and successful completion of future missions. Accordingly, the bill funds the President's requested increases for Research and Program Management in FY 1991.

One of the critical shortages which this country is facing is the lack of individuals having technical skills in science, mathematics, and engineering. An extremely important component of resolving this problem will come from the integration of those who have previously been excluded from the scientific and technical community. Women, minorities, and handicapped have long had extremely little representation in engineering and the physical sciences.

The United States must develop this critical talent through all the means at our disposal. NASA is one of the largest scientific and engineering organizations in the Federal Government. NASA is especially prominent in the sponsorship of programs and research in engineering and the various areas of science. NASA's substantial role means that it can have great influence in helping to bring these under-represented groups into these fields. Accordingly, the Committee expects NASA to work with and assist those research institutions, such as universities, which do substantial work in the technical fields of science, math, and engineering, and which have made particular efforts to bring women, minorities, and handicapped into such endeavors.

In addition, NASA should look to those institutions within this set that are best integrated with industry. There are obvious benefits to NASA to work with scientists who are abreast of developments in similar areas; but perhaps more importantly, those institutions which work closely with industry are more likely to successfully place women, minorities, and handicapped in positions which will lead more quickly to their acceptance in these fields and to serve models for other groups.

Inspector General

Section 101(e) authorizes appropriations to NASA to become available October 1, 1990 for "Inspector General". This subsection authorizes a total of $11,000,000 to support the activities of the Office of the Inspector General of NASA. This amount is the same

as the President's request for FY 1991, and reflects the Committee's strong support of the NASA Inspector General's Office.

The NASA Office of Inspector General (OIG), established by the Inspector General Act of 1978 (P.L. 95-452), as amended, performs a balanced program of audits and investigations of NASA's programs and operations; promotes economy, efficiency, and effectiveness in the administration of programs and operations; and keeps the Administrator and Congress fully and currently informed about NASA programs, deficiencies relating to the administration of such programs, and the necessity for and progress of corrective actions. The OIG works jointly with other Offices of Inspector General, the Federal Bureau of Investigation (FBI), the Defense Contract Audit Agency (DCAA) and other audit and investigative entities when concurrent jurisdiction exists.

Inspector General—Committee Comments

The Committee has established a close working relationship with the OIG and has used the Office to investigate some very senstive matters. In each instance, the OIG has handled these matters with dispatch and resolve and in a very professional manner. The Committee expects to maintain this important relationship.

Other Provisions

Section 101(f) authorizes the NASA Administrator, notwithstanding the provisions of subsection (i), to use appropriations made to "Research and Development" and "Space flight, control, and data communications" (1) for any items of a capital nature, other than acquisition of land, which may be required at locations other than NASA installations for the performance of research and development contracts, and (2) for grants to nonprofit institutions of higher education, or to nonprofit organizations whose primary purpose is the conduct of scientific research, for the purchase or construction of additional research facilities. Title to such facilities must be vested in the United States unless the Administrator determines that the national program of aeronautical and space activities will best be served by vesting title in the grantee institution or organization.

Each grant made under this subsection shall be made under conditions determined by the Administrator as necessary to ensure that the United States will receive benefit to justify making that grant. None of the funds appropriated for "Research and development" and "Space flight, control, and data communications" pursuant to this legislation may be used in accordance with this subsection for the construction of any major facility if the estimated cost of that facility, including collateral equipment, exceeds $750,000, unless the Administrator has notified the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives of the nature, location, and estimated cost of such facility.

Section 101(g) states that when so specified and to the extent provided in appropriation Acts, (1) any amount appropriated for "Research and development", for "Space flight, control, and data communications", or for "Construction of facilities" may remain avail-

able without fiscal year limitation, and (2) contracts may be entered into under the "Research and program management" appropriation account for maintenance and operation of facilities and for other services to be provided during the next fiscal year.

Section 101(h) authorizes the use of appropriations made pursuant to subsection (d), but not to exceed $35,000, for scientific consultations or extraordinary expenses upon the approval or authority of the Administrator, and provides that the Administrator's determination shall be final and conclusive upon the accounting officers of the Government.

Section 101(i)(1) authorizes the use of funds appropriated pursuant to subsections (a), (b), and (d), for the construction of new facilities and additions to, repair of, rehabilitation of, or modification of existing facilities, except that the cost of each such project, including collateral equipment, shall not exceed $200,000.

Section 101(i)(2) authorizes the use of funds appropriated under subsections (a) and (b) for unforeseen programmatic facility project needs, except that the cost of each such project, including collateral equipment, shall not exceed $750,000.

Section 101(i)(3) authorizes the use of funds appropriated pursuant to subsection (d) for repair, rehabilitation, or modification of facilities controlled by the General Services Administration, except that the cost of each project, including collateral equipment, shall not exceed $500,000.

SECTION 102.—ADMINISTRATOR'S REPROGRAMMING AUTHORITY

Section 102 authorizes the Administrator (1) to vary the amount prescribed for specific projects identified in section 101(c)(1) through (43) upward by 10 percent, or (2) in order to meet unusual cost variations, to vary such amount upward by 25 percent, following a report to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives. The total cost of all construction work authorized under paragraphs (1) and (2) of this subsection shall not exceed the total of the amounts specified in section 101(c).

SECTION 103.—SPECIAL REPROGRAMMING AUTHORITY FOR CONSTRUCTION OF FACILITIES

Section 103 authorizes the Administrator to transfer an amount not to exceed one-half of one percent of the funds appropriated pursuant to section 101 (a) and (b) to the "Construction of facilities" appropriation account if the Administrator determines that new developments or scientific or engineering changes in the national program of aeronautical and space activities have occurred, and that such changes require the use of additional funds for the purposes of construction, expansion, or modification of facilities at any locations, and that deferral of such action until enactment of the NASA authorization bill would be inconsistent with the interest of the Nation in aeronautical and space activities. The Administrator also may use up to $10,000,000 of the amounts authorized under section 101(c) for such purposes. The funds made available pursuant to this section may be expended to acquire, construct, convert,

rehabilitate, or install permanent or temporary public works, including land acquisition, site preparation, appurtenances, utilities, and equipment. No such funds may be obligated until a period of 30 days has passed after the Administrator or the Administrator's designee has transmitted a written report describing the nature of the construction, its cost, and the reasons therefor to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives.

SECTION 104.—LIMITATIONS ON AUTHORITY

Section 104 provides that, notwithstanding any other provision of this bill, (1) no amount pursuant to this legislation may be used for any program deleted by the Congress from requests as originally made to either the Senate Committee on Commerce, Science, and Transportation of the Senate or the Committee on Science, Space, and Technology of the House of Representatives; (2) no amount appropriated pursuant to this legislation may be used for any program in excess of the amount actually authorized for that particular program by section 101 (a), (b), and (d); and (3) no amount appropriated pursuant to this legislation may be used for any program which has not been presented to either such Committee, unless a period of 30 days has passed after the receipt, by each such committee, of notice given by the Administrator or the Administrator's designee containing a full and complete statement of the action proposed to be taken and the facts and circumstances relied upon in support of such proposed action.

SECTION 105.—GEOGRAPHICAL DISTRIBUTION

Section 105 expresses the sense of Congress that it is in the national interest that consideration be given to geographical distribution of Federal research funds whenever feasible, and that NASA should explore ways and means of distributing its research and development funds whenever feasible. The Committee has annually mandated this provision, believing it is in the national interest.

SECTION 106.—PEACEFUL USES OF SPACE STATION

Section 106 states that no civil space station authorized under section 101(a)(1) of this bill may be used to carry or place in orbit any nuclear weapon or any weapon of mass destruction on any celestial body, or to station any such weapon in space in any other manner. This civil space station only may be used for peaceful purposes.

This section reiterates the past Committee position. It is consistent with existing U.S. treaty obligations (the Outer Space Treaty) and provisions established in the FY 1989 NASA Authorization Act, Public Law 100-685.

SECTION 107.—SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Section 107 authorizes the Administrator to utilize up to 5 percent of the funds provided for the Small Business Innovation Research Program for program management and promotional activities. None of these funds may be used for travel or civil servant

salaries. This provision would make NASA's implementation of the program consistent with other Federal agencies and ideally would result in more commercial applications and spinoffs.

TITLE II—COMMERCIAL SPACE LAUNCH ACT AUTHORIZATION

SECTION 201.—AUTHORIZATION FOR SECRETARY OF TRANSPORTATION

Section 201 authorizes $4,517,000 to be appropriated in FY 1991 to the Secretary of Transportation (Secretary) to carry out the activities of the OCST and to fulfill the Secretary's responsibilities pursuant to the Commercial Space Launch Act (49 App. U.S.C. 2601 et seq.). The OCST was established pursuant to the Commercial Space Launch Act (P.L. 98-575), with the purposes of establishing and enforcing the licensing and regulatory regime for U.S. commercial launch activities, and encouraging, facilitating, and promoting U.S. commercial space launches by the private sector. Within this statutory mandate, the OCST has provided critical policy input on such commercial space issues as the U.S. response to a proposed Australian commercial spaceport. The OCST has also played a pivotal role in promoting a favorable regulatory environment for the growth of the fledgling U.S. commercial launch industry.

To date, nine successful licensed U.S. commercial launches have occurred. The latest commercial launch manifest, released by the OCST, shows that 34 more U.S. commercial launches are expected to take place into the mid-1990s. Indications are that the launch manifest may grow dramatically as more launch contracts are signed in the coming years. The OCST has estimated that in FY 1991 alone, as many as 40 U.S. commercial space launches are expected.

To ensure proper and thorough review of these applications, the Committee supports the OCST FY 1991 budget request. Adequate resources to oversee and regulate properly the commercial ELV industry are essential to ensure that the United States can fulfill its obligations under international treaties, as well as to protect fully the health and safety of the public.

TITLE III—NATIONAL SPACE COUNCIL AUTHORIZATION

SECTION 301.—COUNCIL AUTHORIZATION

Section 301 authorizes $1,363,000 to be appropriated in FY 1991 to carry out the activities of the National Space Council, established pursuant to the NASA Authorization Act, FY 1989 (42 U.S.C. 2471).

CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new material is printed in italic, existing law in which no change is proposed is shown in roman):

COMMERCIAL SPACE LAUNCH ACT

Section 24 of that Act

[AUTHORIZED APPROPRIATIONS

[SEC. 24. There are authorized to be appropriated to the Secretary $4,000,000 for fiscal year 1985. There is authorized to be appropriated to the Secretary to carry out this Act $586,000 for fiscal year 1986. There is authorized to be appropriated to the Secretary to carry out this Act $4,548,000 for fiscal year 1988. There is authorized to be appropriated to the Secretary to carry out this Act $3,827,000 for fiscal year 1989.]

AUTHORIZED APPROPRIATIONS

SEC. 24. There is authorized to be appropriated to the Secretary to carry out this Act $4,517,000 for fiscal year 1991. Sums appropriated for research and development shall remain available until expended.

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